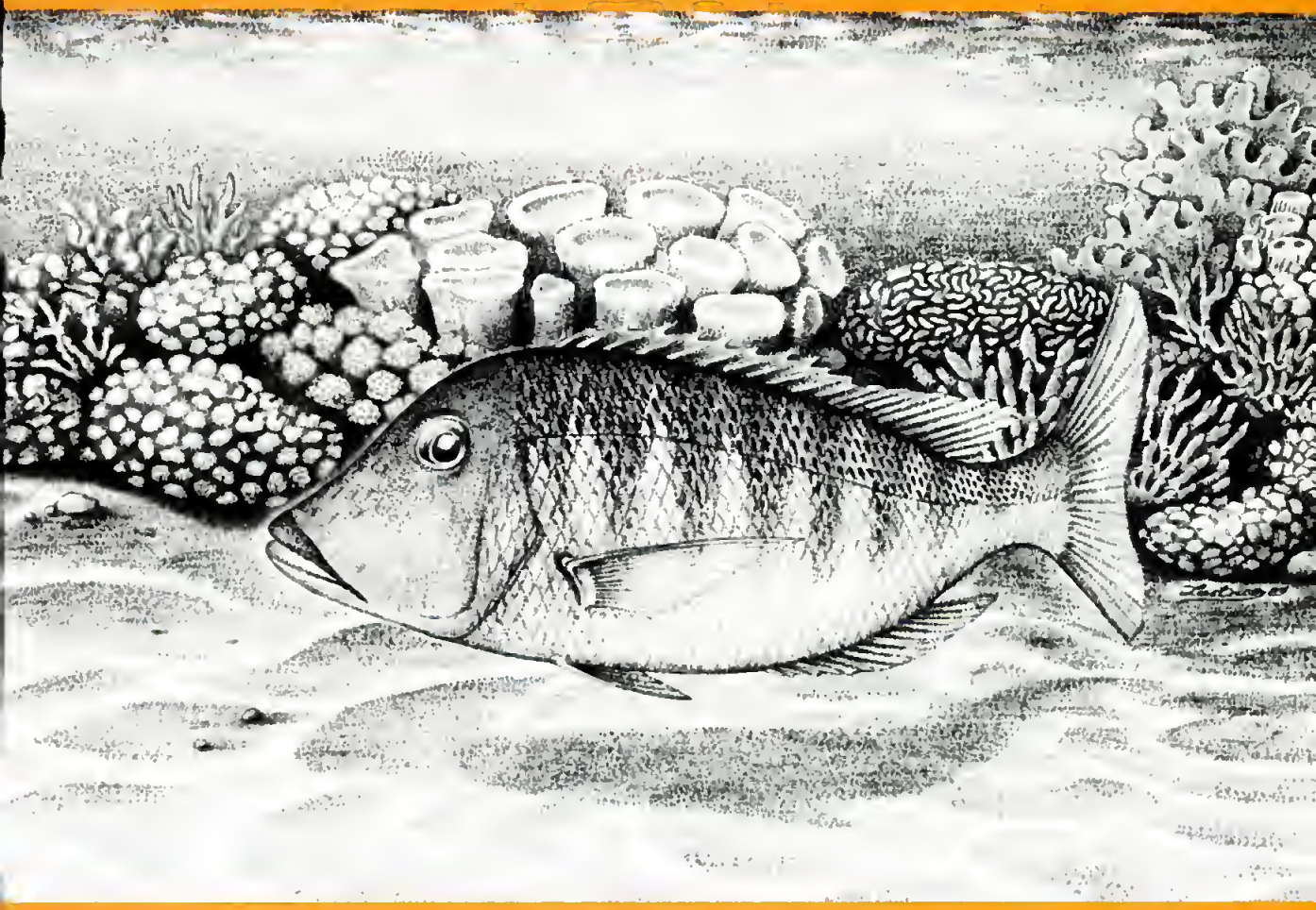
FAO Fisheries Synopsis No. 125, Volume 9 FIR/S125 Vol. 9

FAO SPECIES CATALOGUE

VOL. 9. EMPEROR FISHES AND LARGE-EYE BREAMS OF THE WORLD

(FAMILY LETHRINIDAE)

AN ANNOTATED AND ILLUSTRATED CATALOGUE OF LETHRINID SPECIES KNOWN TO DATE



UNITED NATIONS DEVELOPMENT PROGRAMME
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FAO Fisheries Synopsis No. 125, Volume 9 FIR/S125 Vol. 9

FAO SPECIES CATALOGUE

VOL. 9 EMPEROR FISHES AND LARGE-EYE BREAMS OF THE WORLD

(Family Lethrinidae)

An Annotated and Illustrated Catalogue

of Lethrinid Species Known to Date

prepared by

Kent E. Carpenter
Mariculture and Fisheries Department
Kuwait Institute for Scientific Research
P.O. Box 1638
22017 Salmiya, Kuwait

and

Gerald R. Allen
Western Australian Museum
Francis Street
Perth, Australia

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Rome, 1989

The designations employed and the presentation of material in this publication do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

M-40/T0242E/1/1.90/2500
ISBN 92-5-102889-3

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior permission of the copyright owner. Applications for such permission, with a statement of the purpose and extent of the reproduction, should be addressed to the Director, Publications Division, Food and Agriculture Organization of the United Nations, Via delle Terme di Caracalla, 00100 Rome, Italy.

© FAO Rome 1989

PREPARATION OF THIS DOCUMENT

Although most emperor fishes and large-eye breams are of significant interest to fisheries in the Indo-Pacific region, information on their biology and fisheries is rather scanty, largely due to the difficulties with correct identification of the species in this group.

The authors of the present catalogue are engaged since several years in a world-wide revision of the family. Even if the completion of their study will probably take several more years, they have made substantial progress in the basic taxonomy of the most important commercial representatives, namely the species of the genus ***Lethrinus***, and it hence appears justified to make these finding available without delay to the fishery workers who need them for their daily work.

K. Carpenter has prepared the material pertaining to the 28 species of the genus ***Lethrinus***, while G R Allen wrote the accounts on the 11 species belonging to the other genera, e.g ***Gnathodentex***, ***Gymnocranius***, ***Monotaxis*** and ***Wattsia***. The work of the authors has been based, apart from a comprehensive review of pertinent literature, on the study of type specimens kept in the major museum collections in Europe and the USA, and on the examination of fresh material from various parts of the world.

In view of the importance of colour patterns as diagnostic characters for identification, colour plates for all species have been included.

The problems still pending regard in particular the taxonomy of the species of ***Gymnocranius*** and the assignation of valid scientific names to 2 species of ***Lethrinus*** and to1 species of ***Gymnocranius***.

Technical Editors: W. Fischer, Nadia Scialabba and W. Schneider, Fisheries Resources and Environment Division, FAO

Illustrators: R. Swainston, Perth, Australia and P. Lastrico, FAO, Rome

Page composition: G. Sciarappa-Demuro, FAO, Rome

Carpenter, K.E., Allen, G.R.
FAO species catalogue. Vol. 9. Emperor fishes and large-eye breams of the world (family Lethrinidae). An annotated and illustrated catalogue of lethrinid species known to date.
FAO Fisheries Synopsis No. 125, Volume 9. Rome, FAO. 1989. 118p.

ABSTRACT

This is the ninth issue in the FAO series of worldwide annotated and illustrated catalogues of major groups of organisms that enter marine fisheries. The present volume includes 39 lethrinid species belonging to 5 genera. It comprises an introductory section with general remarks on the systematics, habitat and fisheries of the family, a glossary of technical terms used, illustrated keys to genera and species, and detailed accounts on all species. Species accounts include drawings, scientific and vernacular names, information on habitat, biology and fisheries, and a distribution map. Lists of nominal species in the family, a table of species by major marine fishing areas and colour plates follow the species accounts. The work is fully indexed and there is ample reference to pertinent literature.

Distribution

Authors
FAO Fisheries Officers
Regional Fisheries Councils and Commissions
Selector SC

This One
Y6BS-CGZ-J3RN

TABLE OF CONTENTS

Page

1. INTRODUCTION 1

1.1 Plan of the Catalogue 2
1.2 General Remarks on Lethrinids 3
1.3 Illustrated Glossary of Technical Terms and Measurements 10

2. SYSTEMATIC CATALOGUE 14

2.1 Diagnostic features of the Family Lethrinidae 14
2.2 Illustrated key to Genera and Species of Monotypic Genera 14
2.3 Information by Species 17

	Code	
Gnathodentex	LETH Gnath	17
Gnathodentex aurolineatus	LETH Gnath 1	17
Gymnocranius	LETH Gymno	18
Gymnocranius audleyi	LETH Gymno 3	22
Gymnocranius elongatus	LETH Gymno 4	23
Gymnocranius euanus	LETH Gymno 5	24
Gymnocranius frenatus	LETH Gymno 6	25
Gymnocranius grandoculis	LETH Gymno 2	27
Gymnocranius griseus	LETH Gymno 1	28
Gymnocranius microdon	LETH Gymno 7	30
Gymnocranius sp.	LETH Gymno 8	31
Lethrinus	LETH Leth	33
Lethrinus amboinensis	LETH Leth 21	47
Lethrinus atkinsoni	LETH Leth 22	48
Lethrinus atlanticus	LETH Leth 8	50
Lethrinus borbonicus	LETH Leth 13	51
Lethrinus conchyliatus	LETH Leth 9	53
Lethrinus crocineus	LETH Leth 10	54
Lethrinus enigmaticus	LETH Leth 23	55
Lethrinus erythracanthus	LETH Leth 3	57
Lethrinus erythropterus	LETH Leth 11	59
Lethrinus genivittatus	LETH Leth 6	61
Lethrinus haematopterus	LETH Leth 24	63
Lethrinus harak	LETH Leth 2	64
Lethrinus laticaudis	LETH Leth 25	66
Lethrinus lentjan	LETH Leth 4	67
Lethrinus mahsena	LETH Leth 12	69
Lethrinus microdon	LETH Leth 14	71
Lethrinus miniatus	LETH Leth 26	73
Lethrinus nebulosus	LETH Leth 15	75
Lethrinus obsoletus	LETH Leth 16	77
Lethrinus olivaceus	LETH Leth 5	78
Lethrinus ornatus	LETH Leth 7	80
Lethrinus reticulatus	LETH Leth 27	81
Lethrinus rubrioperculatus	LETH Leth 17	83
Lethrinus semicinctus	LETH Leth 18	84
Lethrinus sp. 1	LETH Leth 28	86
Lethrinus sp. 2	LETH Leth 29	87
Lethrinus variegatus	LETH Leth 19	88
Lethrinus xanthochilus	LETH Leth 20	89

Copyrighted material

Monotaxis ..... LETH Mono 91
Monotaxis grandoculis ..... LETH Mono 1 91

Wattsia ..... LETH Watt 92
Wattsia mossambica ..... LETH Watt 1 93

3. LIST OF NOMINAL SPECIES OF LETHRINIDAE 95

4. LIST OF SPECIES BY MAJOR FISHING AREAS 98

5. BIBLIOGRAPHY 101

6. INDEX OF SCIENTIFIC AND VERNACULAR NAMES 111

7. COLOUR PLATES 118

Copyright-free material

1. INTRODUCTION

This catalogue presents fisheries-related and identification information for the 39 presently recognized species of emperors and large-eye breams (emperors are also sometimes collectively referred to as scavengers, pig-face breams, barefaces, and emperor snappers). The details on biology, ecology, catch statistics and fishing techniques come principally from the literature. These data are abundant for some species and scarce for others, mostly because lethrinids vary widely in their importance to fisheries. The taxonomic information in this catalogue is based on an ongoing revision of the family (G.R. Allen has taken the lead in the revision of ***Gnathodentex, Gymnocranius, Monotaxis*** and ***Wattsia***, while K.E. Carpenter has taken the lead in the revision of ***Lethrinus***). There has been much progress in solving the numerous taxonomic problems and further research is aimed at resolving the remaining uncertainties. The interested reader is alerted to a forthcoming revision by the authors.

Taxonomically, lethrinids are considered one of the most problematic of tropical marine fish families. Several major attempts at revision of this group have been made in this century, and these accounts are laced with lamentations regarding the perplexity encountered. For example, Smith (1959) stated: "It must be emphasized, however, that at present, the positive identification of certain species, preserved, without colour notes from fresh specimens, is, especially with juveniles, a formidable, almost impossible task. In scarcely any other group of marine fishes it is so difficult to decide the true definition of some of the species." Walker (1975) summed up his taxonomic experience with lethrinids: "For one can only emerge from such a study, particularly of preserved material, with a feeling of humility and some apprehension." Sato (1978, 1986), who has worked on both subfamilies of lethrinids remarked on the genus ***Lethrinus***: "The intrageneric systematics within this genus, however, has been in great chaos .." and for the Monotaxinae, "I have tried to review this subfamily and to show major moot points."

Due to the problems in identifying preserved specimens of lethrinids, it is no wonder that the earliest taxonomists gave many different names to the same species. The most prolific earlier worker on this group, Valenciennes (in Cuvier & Valenciennes, 1830), recognized 37 species of the genus ***Lethrinus***, 31 of these were new names. Today, we recognize 27 species of ***Lethrinus***, of which only 11 of Valenciennes' names are valid. In fact, Valenciennes assigned nine different new names to the species that we recognize here as ***L. nebulosus***. Pieter Bleeker, the eminent Dutch ichthyologist who spent much of his life studying fishes in Indonesia in the 19th century, named 17 species of lethrinids, three of which we recognize here as valid. Only the earliest worker on lethrinids, Forsskål (1775), was successful in naming a number of species, all of which we recognize as valid. This is mainly because he was the first taxonomist to work on lethrinids and, he worked only on the few lethrinid species from the Red Sea, which are relatively easy to differentiate.

The problems previously encountered in identification of lethrinids are primarily due to the fact that many of the characters traditionally used to differentiate fishes are relatively constant among certain species of lethrinids. When they are live or still fresh, colour can be very helpful for species determination. Body colours and markings also add to the confusion because they can change substantially according to the time of day, the emotional state of the fish, geographic locality, and state of freshness. Despite these problems, previous researchers have contributed to our understanding of the systematics of lethrinids and have revealed a number of characters that help differentiate species. For example, Sato (1978) found that the pattern of dark pigment cells, or melanophores, on the membranes of the pelvic fin, help differentiate some species which were previously difficult to separate. In preparation for this publication, 75 different counts, measurements and observations were taken on each of over 450 specimens of ***Lethrinus***, representing all species, including most of the type specimens found in major museums in the United States, Europe and Australia. Of the 75 characters found to vary among ***Lethrinus***, 25 are presented here in detail. Among these 25 useful characters there are some that have not previously been used to differentiate species of ***Lethrinus***. An additional 310 specimens were examined for key characters in museums and from collections made specifically for lethrinids in the Philippines, Thailand, and the Arabian Gulf. This catalogue is timely therefore as a report on the progress in taxonomic work on lethrinids and to clear up many of the identification problems that have existed.

In keeping with the format and style of the "FAO Species Catalogue" series, literature citations in the text have been kept to a minimum. The literature that has been consulted is listed in the bibliography. A glossary of technical terms and illustrations are included to reduce the necessity to consult other sources for identification purposes.

Copyrighted material

Acknowledgments

We extend gratitude to the following persons and institutions who assisted during museum visits, provided specimens or loans of specimens, or in some way ameliorated our understanding of lethrinids: S.M Almatar, N Downing and J.M McCulloch (Kuwait Institute for Scientific Research, Kuwait); M.L Bauchot and M Desoutter (Muséum National d'Histoire Naturelle, Paris); S. Blum and C.J. Ferraris (American Museum of Natural History, New York); G. Bohlke and W.F. Smith-Vaniz (Academy of Natural Sciences, Philidelphia); D. Catania, W N Eschmeyer and W.I. Follett (California Academy of Science, San Francisco); R R. Carthy, S L. Jewett, G.D. Johnson, L.W. Knapp, T.M. Orrell, S.J. Raredon, V.G. Springer, and J.T. Williams (United States National Museum of Natural History, Washington, D.C.); P Colin (Motupore Island Research Station, University of Papua and New Guinea); M.F. Gomon (Museum of Victoria, Melbourne); P.C. Heemstra and B. Ranchod (J.L B Smith Institute of Ichthyology, Grahamstown, South Africa); D.F Hoese, J M. Leis, M McGrouther and J R Paxton (Australian Museum, Sydney); M.L Holloway, G.J. Howes, and A Wheeler (British Museum, Natural History), London; J.B. Hutchins (Western Australian Museum, Perth); M. Jebb (Christensen Research Institute, Madang, Papua and New Guinea); M van der Knaap (FAO Maldives); F. Krupp and H Zetzsche (Natur-Museum Senckenberg, Frankfurt); K. Larson and B.C. Russell (Northern Territory Museum, Darwin); K Matsura (National Science Museum, Tokyo); R. McKay (Queensland Museum, Brisbane); J. Menne and J. Nielsen (Zoologisk Museum, Copenhagen); H. Nijssen (Zoölogisch Museum, Amsterdam); M.J.P. van Oijen (Rijksmuseum van Natuurlijke Historie, Leiden); H.J. Paepke (Museum fur Naturkunde, Berlin); R.L. Pyle, J.E. Randall and A Y. Suzumoto (B P Bishop Museum, Honolulu).

Thanks are also due to W A Starck and R C. Steene for assisting G R Allen with the collection of lethrinid specimens on the Great Barrier Reef of Australia and the Coral Sea. Mr Steene also gave us copies of lethrinid photos that were useful for colour descriptions Likewise, R H. Kuiter donated several colour photographs.

We offer special thanks to J.E Randall who made available his collection of lethrinid colour transparencies; these were a tremendous aid in our work Jack's enthusiasm for finding solutions to the many taxonomic problems plaguing the Lethrinidae served as inspiration and impetus for our work.

We are grateful to the illustrators, R. Swainston and P. Lastrico who prepared the colour paintings and drawings for this catalogue

We acknowledge W Fischer who secured support for museum visits and field work through FAO and whose dedication and energy made this catalogue possible We thank W. Schneider, N Scialabba and G Sciarappa-Demuro for making the final editing session both successful and enjoyable.

Special gratitude is due to Cecilia Luz M Carpenter for her patience, and the countless hours spent in helping to collect and computerize data on lethrinid specimens; a comprehensive review of ***Lethrinus*** for this catalogue would not have been possible without her help; and to Connie Allen who provided considerable assistance with library work, data processing and preparation of the typescript. M Eustaquio assisted in osteolgical preparations. The C.O Minsalan family provided laboratory space during field work in the Philippines

1.1 Plan of the Catalogue

A family description is given, followed by a key to genera which includes the species of monotypic genera The species accounts are arranged alphabetically by genera and species. Each genus is introduced with its type reference and synonyms Descriptions of genera with more than one species also list diagnostic features and, comments on general biology, habitat, distribution, and interest to fisheries. The genus descriptions are followed by a key to the species and species accounts in alphabetical order. The information pertaining to each species is arranged by paragraphs, in the order listed below:

(1) **Scientific Name:** The reference for the original description and type locality is given.

(2) **Synonyms :** All invalid names and combinations that have been applied are referenced.

(3) **FAO Name :** The FAO English name is considered the standard to be used for fishery purposes. This should avoid confusion which can be caused due to the existence of multiple names for the same species or the same name for several species The FAO name is not intended to supplant the use of local names but rather, to serve as a worldwide reference FAO French and Spanish species names are not yet available.

(4) **Diagnostic Features :** Distinctive characters of the species are given as an aid for identification, accompanied by useful diagrams. These diagnoses should be consulted to confirm species identified using the illustrated key

(5) **Geographical Distribution:** The general geographic range is given in the text and illustrated on a map. The map shading includes known areas of occurrence and intermediate areas between locality records where a species is expected to be found.

(6) **Habitat and Biology:** Information on habitat, behaviour, food habits and reproduction is given.

(7) **Size:** The approximate maximum total length is given.

(8) **Interest to Fisheries:** General information on the extent, type of fisheries, and utilization are given. Detailed fisheries data is unavailable for all species and therefore, only a qualitative assessment is possible.

(9) **Local Names:** These are given where published names are available. Often, a single local name is applied to several species.

(10) **Literature:** Recent references which contain illustrations that could be useful for identification are given. It is stated if an incorrect name is given in the reference.

(11) **Remarks:** Useful information which is not appropriately covered in the previous paragraphs is included here. Frequently used incorrect scientific names are mentioned here.

1.2 General Remarks on Lethrinids

Systematics : The Lethrinidae are tropical marine perciforms found entirely in the Indo-Pacific, except one species that occurs only in the eastern Atlantic. They belong to the suborder Percoidei, a diverse group containing many families whose relationships are poorly understood. Within this suborder, lethrinids are included under the superfamily Sparoidea which also contains the families Sparidae (porgies), Centracanthidae and Nemipteridae (threadfin bream). Among percoids, sparoids appear most closely related to the Lutjanoidea (includes the snappers or Lutjanidae and, fusiliers or Caesionidae) and the Haemuloidea (includes the grunts or Haemulidae and Inermiidae). There has been much confusion concerning the familial allocation of the genera and species amongst these groups.

Akazaki (1962) and Johnson (1981) defined the limits of sparoid fishes. They present convincing evidence to support the integrity of what are currently considered the constituent genera of the Sparidae, Centracanthidae, Nemipteridae and Lethrinidae. The genera included in the Lethrinidae are ***Gnathodentex***, ***Gymnocranius***, ***Lethrinus***, ***Monotaxis*** and, ***Wattsia***. These genera are divided into two subfamilies by some taxonomists (Fig. 1), although the integrity of this classification is still in need of critical evaluation. A phylogenetic analysis of this group is currently in progress. A problem encountered in this analysis is the determination of outgroup relations and polarity of character states within the Lethrinidae. The supraspecific classification presented here is therefore considered provisional.

Table 1 lists the major characters that vary among the genera of the Lethrinidae. Many of these characters are easily observable and there is no problem in distinguishing between genera. The number of dorsal and anal fin rays, the presence or absence of scales on the cheek, and the presence of certain bony structures on the maxilla are constant within genera and serve as convenient aids in identification. Three of the five genera of lethrinids are monotypic (***Gnathodentex***, ***Monotaxis***, and ***Wattsia***) and the integrity of these taxa appears incontroversible. The almost effortless task of differentiating among genera of lethrinids does not properly prepare one for the many difficulties that can be encountered in separating species within the multispecies genera ***Gymnocranius*** and ***Lethrinus***. No attempts have been made to separate subgenera within ***Gymnocranius***. In ***Lethrinus*** however, some taxonomists have divided this genus into different genera or subgenera. These attempts have centered around differences in dentition and lateral teeth types; ***Lethrinella*** has been meant to include species with long snouts and conical lateral teeth while ***Lethrinus*** includes species with short snouts and rounded or molariform lateral teeth. There are many intermediates in these basic forms however, and it is difficult to assign some species to one or the other taxa; subdivisions within the genus ***Lethrinus*** are generally ignored in recent work. We prefer to defer any recognition of supraspecific division within what we recognize as ***Lethrinus*** or ***Gymnocranius*** until a thorough evaluation of phylogenetic relationships within these genera is complete.

Habitat and Biology: Lethrinids are bottom-feeding, carnivorous, coastal fishes, ranging primarily on or near reefs. They generally possess large, strong jaws and food preference is correlated with the type of lateral jaw teeth and to a certain extent, the length and angle of the snout found in a particular species. For example, the humpnose big-eye bream, ***Monotaxis grandoculis***, has large, well-developed molars, and a short, blunt snout. It consumes molluscs, sea urchins and other hard-shell invertebrates. At the other extreme, the longface emperor, ***Lethrinus olivaceus***, has conical lateral teeth, and an elongate, gradually sloping snout. It feeds mainly on fishes.

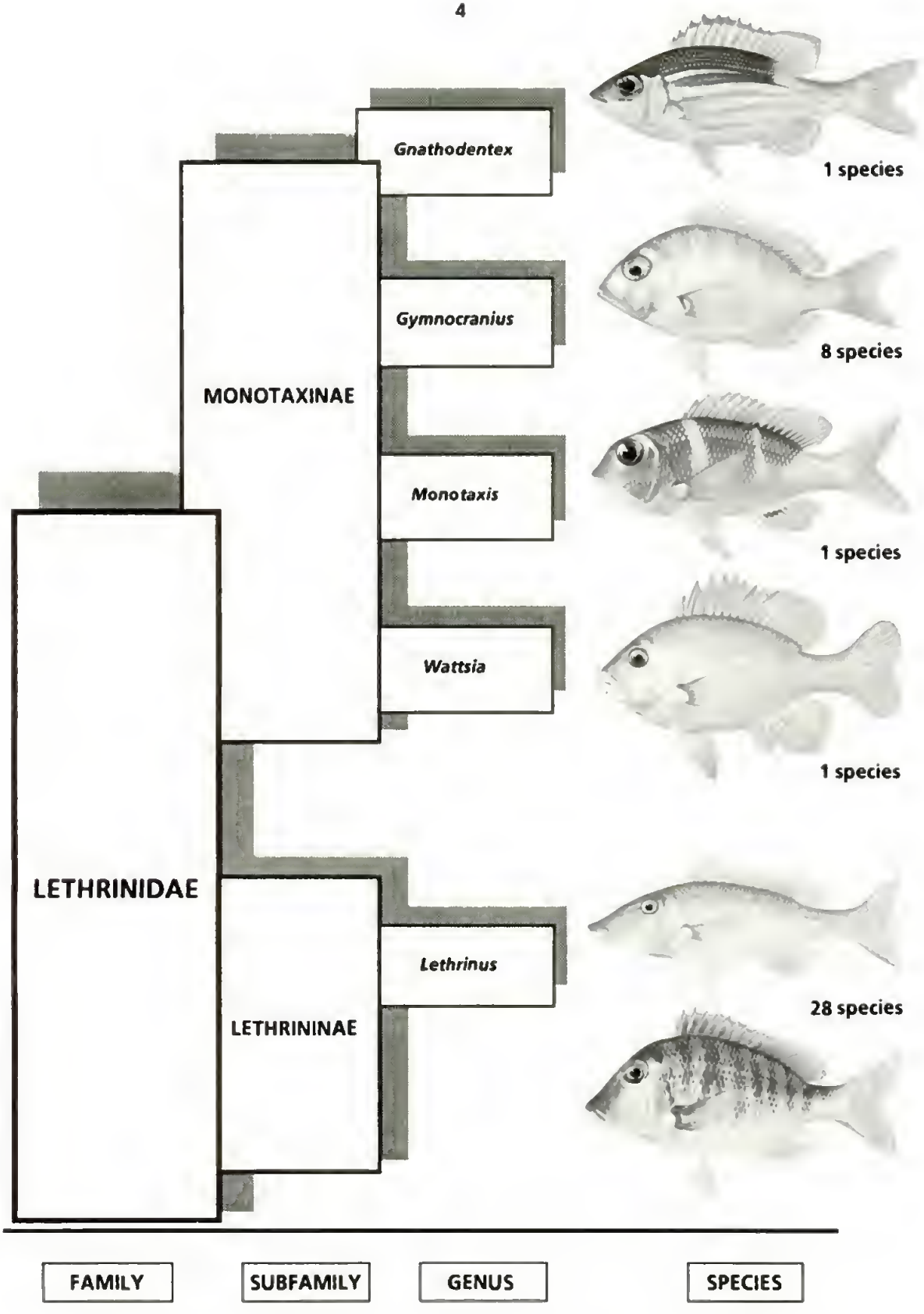


Fig. 1 A provisional classification of the subfamilies and genera of the Family Lethrinidae

Copyrighted material

Table 1

Characters found to vary among genera of the Lethrinidae

	Gnathodentex	*Gymnocranius*	*Wattsia*	*Monotaxis*	*Lethrinus*
Dorsal rays	10	10	10	10	9
Anal rays	8-9	9-10	10	9	8
Pectoral rays	15	14	14	14	13
Lateral-line scales	68-74	46-49	41-47	44-47	42-49
Scales above lateral line	5	5-6	5	4-5	5-6
Cheek scales	+	+	+	+	-
Pectoral axil scales	-	-	-	+	- +
Maxilla surface	denticulated	smooth	denticulated	denticulated	smooth, knob ridge
Lateral teeth	conical	conical, molars	conical	molars	conical, molars
Ascending premax. process to alveolar ramus ratio	>1	>1	>1	=	>1
Subocular shelf	+	+	+	+	-
Epiotic-pterotic suture	narrow	narrow	narrow	narrow	broad
Vertical sphenotic flange	eroded	eroded	eroded	eroded	entire

and crustaceans. Between these extremes, species exhibit many intermediate lateral teeth types, from molar through rounded to conical, and snout shape also varies widely. Diet concommittantly varies between the extremes from primarily hard-shell invertebrates, to soft-shell invertebrates, to fishes, with combinations of these food items found in many species. There is also a great deal of selectivity for particular food items. For example, the predominant food eaten by some species is sea urchins. Food items most commonly reported for lethrinids are polychaetes, crabs, shrimps, gastropods, bivalves, squid, octopus, sea urchins, sand dollars, starfish, brittle stars, and fish. Feeding in most species is done at night, although many species forage coincidentally or purposefully during the day. Diurnal feeding migrations are reported for some species. For example, ***Lethrinus borbonicus*** typically ranges over sandy bottom during the day and at night they feed actively over the reef. Another species, ***L. miniatus***, reportedly rests on the reef during the day and actively forages over sand bottoms at night.

Lethrinids are mostly reef fishes but their preferred habitat is sandy or rubble substrate. The reefs which they frequent can be shallow, coralline reefs or deep, rocky reefs. One species frequents the outer edges of the continental shelf and is caught to depths of 180 m. Lethrinids can be solitary or schooling and do not appear to be territorial. They often form large aggregations while spawning.

Sequential protogynous hermaphroditism is apparently the usual mode of sexuality in lethrinids, that is, when sexually mature they are initially females and later in life they change sex. This explains certain characteristics of lethrinid populations: males tend to be larger on the average than females and there is usually a sex ratio slightly in favor of females. There is considerable overlap in size distributions between males and females suggesting that sexual transformation occurs over a wide size range. The testes of males that have been examined histologically (Young & Martin, 1982) show typical secondary male (having transformed from an ovary) characteristics and no evidence has been found to support occurrence of primary males (testes form without going through an ovary stage).

There are few reports on the spawning behavior of lethrinids. This is not surprising since it is thought that most lethrinids spawn after dark. Much of what is reported about the spawning behavior of emperors comes from observations by fishermen (Johannes, 1981). Spawning is apparently preceded by local migrations at dusk to

particular areas near a reef, either in a lagoon or on the outer edge of a reef. Spawning occurs in large aggregations while swimming in circles near the surface or, at the bottom of reef slopes. This activity is at a peak around the time of the new moon.

Spawing seasonality varies widely among different species of lethrinids, and for some species, it varies between localities. Spawning is generally prolonged throughout the year with peaks occurring in different seasons. For example, Toor (1964) reports spawning in the redspot emperor to occur mostly from December to February and again from June to August in India. Loubens (1980a) reports a high percent of sexually mature individuals of the redspot emperor between September and December in New Caledonia. In the Red Sea, Kedidi (1984) reports peaks in sexually mature females for this species in January and again in April-May. Fecundity for the redspot emperor was estimated at 12 000 to 77 000 eggs spawned per female per year (Toor, 1964).

Courtship behaviour has been reported for the grey large-eye bream in a public oceanarium during May and June shortly after dusk (Suzuki & Hioki, 1978). During courtship, males assume a colour pattern different from its normal pattern, with several wavy silver stripes on the sides. Females remain motionless in aggregations near the bottom and males initiate spawning by nudging the abdomen of the female with their snouts. The pair then ascend slowly toward the surface together and release their gametes simultaneously at a depth of about one or two meters; release is followed by a quick return to the bottom.

The only sexual dimorphism reported for lethrinids is the average larger size of males and the courtship colouration described for the grey large-eye bream. It is possible however, that future studies may reveal different courtship colours for other lethrinids. This is one possible mechanism for the various colour patterns observed in some emperors.

Fertilized eggs reported for lethrinids are pelagic with an oil globule, spherical, colourless and between 0.68 to 0.83 mm in diameter (Fig. 2). Normally, hatching occurs 21 to 40 hrs after fertilization. Newly hatched larvae are 1.3 - 1.7 mm with an unopened mouth, unpigmented eyes, a large yolk sac and variable body pigmentation. Notable characteristics of the larvae are extensively developed head spination and cheek scales (Fig. 3).

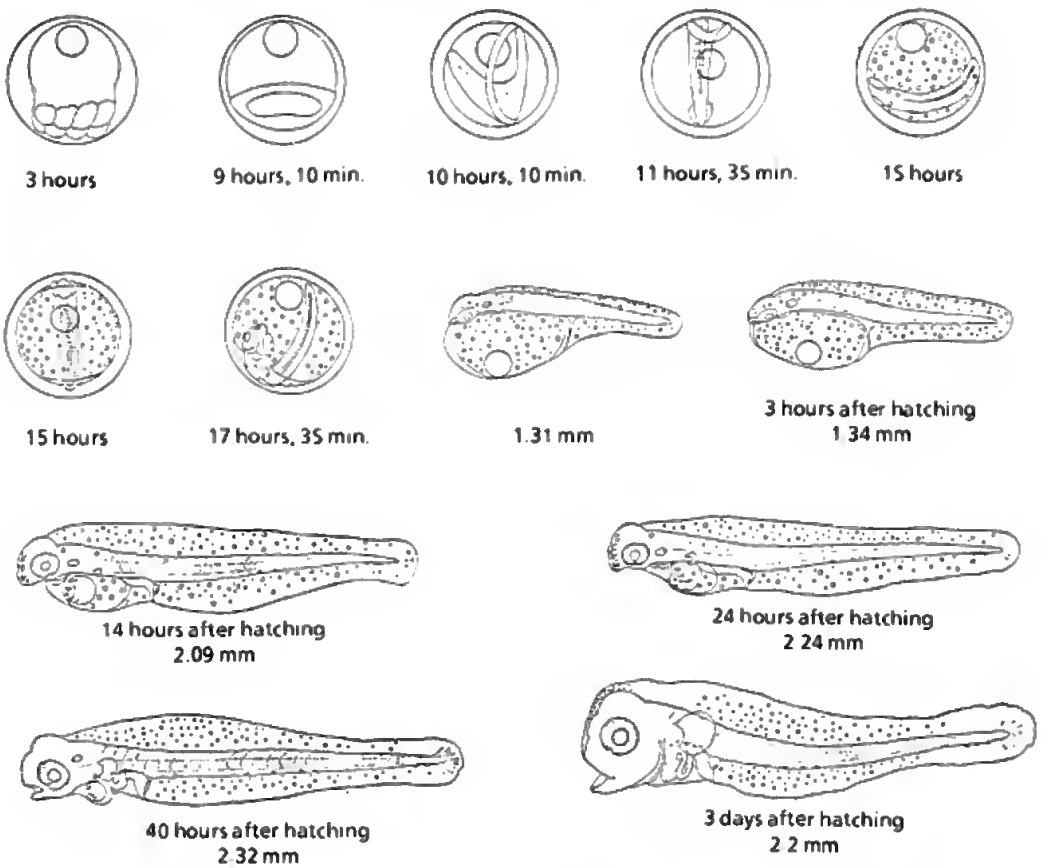


Fig. 2 Developmental series of *Gymnocranius griseus* (from Renzhai & Suifen, 1980)

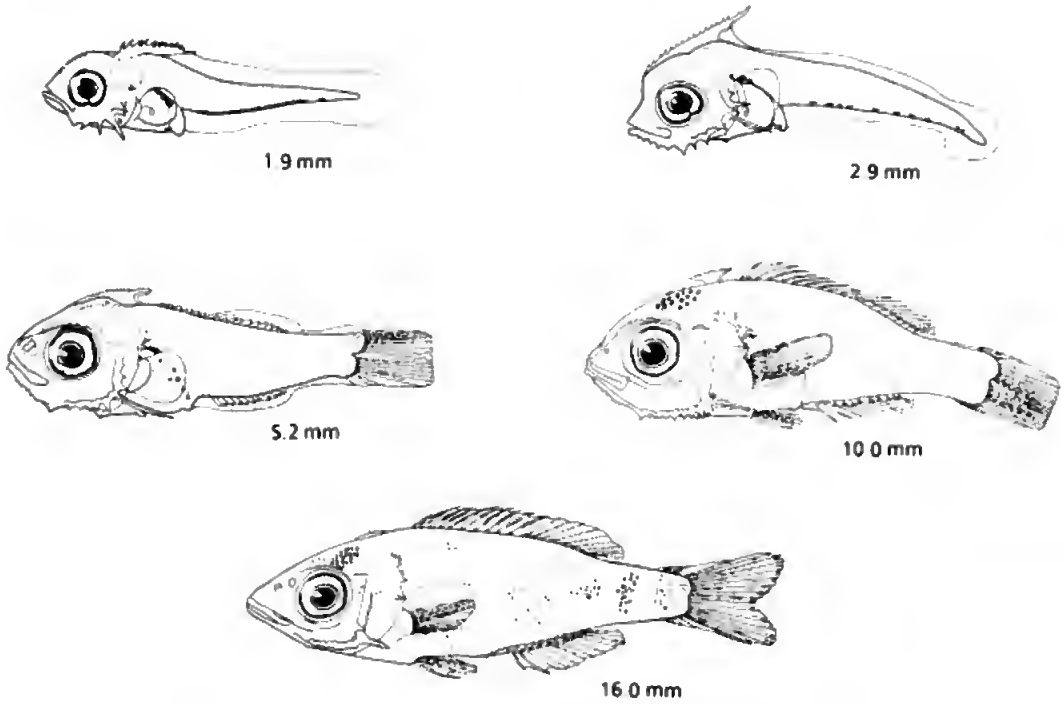


Fig. 3 *Lethrinus* larvae (probably more than one species) from Leis & Rennis, 1983.

Lethrinids are relatively long-lived fishes The average maximum observed age reported for nine species of lethrinids is 17 years; the range of maximum observed age is seven to 27 years. Average age of growth cessation is 11 years; the range, four to 17 years. Both scales and otoliths have been used to age lethrinids and annual mark formation on these structures are generally distinct

Population dynamics of lethrinids have been studied widely and the von Bertalanffy growth parameters asymptotic length ($L_{infinity}$) and the coefficient of growth (K) are known for populations of over 15 species. The asymptotic length ranges from about 19 cm total length for the smallest species studied to over 100 cm total length for the largest Growth coefficient estimates range from around 0.1 to 0.9. Estimates of rate of natural mortality range from 0 5 to 1 9

Fisheries: Emperors and large-eye breams are an important component of commercial, recreational and artisanal fisheries of the world, although the degree of importance varies. At certain localities and times, a species may be the major focus of a fishery, or the most prized catch Some lethrinids however, never gain notable importance to fisheries, usually because of their small size or because they are relatively uncommon, but all species are invariably caught and consumed in particular countries There has been a more-or-less steady increase in the reported total world catch of lethrinids (mostly commercial fisheries) from 28 242 to 57 887 metric tons over the period 1980 to 1987 (Table 2). This reported catch is from the western central Pacific (including Hong Kong), the eastern Indian Ocean, and the western Indian Ocean; the latter area contributing the greatest percent catch (Table 3). The catch of lethrinids is relatively small compared to the total world catch of fishes (in 1987, this was 92 693 400 metric tons), but for certain countries, lethrinids are of primary importance to fisheries (Table 4). In 1987, lethrinids were the most important fish group in terms of contribution of weight to the fisheries in Mauritius (31% of total catch by weight) and Qatar (25% of total catch by weight); and they are among the top four most important also in Bahrain, Fiji, Saudi Arabia, the United Arab Emirates and the Yemen Arab Republic.

The reported world catch of lethrinids is greatly underestimated in the above account, either because of difficulties in tabulating statistics from different countries, or simply because the catch of lethrinids goes unreported as part of an artisanal or sport fisheries For example, in the Philippines which is not reported to contribute to the world catch in the above statistics, lethrinids are very common in markets but reported as "Porgies"; a name generally referred to sparids but in the Philippines these refer mostly to lethrinids The

Table 2

Reported world catch of emperors and large-eye bream in metric tons (FAO, 1989)

	1980	1981	1982	1983	1984	1985	1986	1987
Emperors	26 987	33 620	34 613	43 300	44 364	42 978	51 159	56 710
Large-eye breams	1 255	1 194	1 091	936	882	808	829	1 177
TOTAL LETHRINIDS	28 242	34 814	35 704	44 236	45 246	43 786	51 988	57 887

Table 3

Reported catch of emperors and large-eye breams by fishing area for the year 1987

	Catch (mt)	% Total
Western Central Pacific (incl. Hong Kong)	17 444	30%
Eastern Indian Ocean	2 044	4%
Western Indian Ocean	38 399	66%

average annual catch of lethrinids in the Philippines is estimated at around 11000 metric tons which would increase the above estimates by 19%! Another country not included in the world catch of lethrinids is Kuwait, which averages 50 to 100 metric tons of lethrinids per year (total catch of fin fish in Kuwait usually between 5 000 to 7 500) and lethrinids are considered one of the most valuable market fishes. Other countries which report lethrinids as common or valuable in their fisheries but are not reported as part of the world catch include Australia, India, Japan, the Maldives, Papua New Guinea, Sri Lanka, Taiwan, Thailand, and various countries of Micronesia, Melanesia and Polynesia.

In most areas where lethrinids are fished, stocks are near the level of maximum exploitation. In some areas, however (e.g. the trap fishery in the Tuamotus), lethrinids appear to be overfished. Certain stock assessment activities in this decade also indicate a large potential exploitable stock of lethrinids (e.g. northern Australia) or possibility of further exploitation (e.g. Mauritius Banks).

Lethrinids are potentially utilizable in aquaculture. Certain species grow well in cage culture and at least one species, ***L. nebulosus*** was shown to be tolerant of low salinities. Research also indicates that lethrinid larval culture is feasible.

Emperors are an important component of recreational fisheries in some countries. In Australia, they are one of the most popular sport fishes because they are powerful adversaries. It is not uncommon for keen anglers to travel hundreds of kilometers for the challenge of landing certain emperors.

Lethrinids are caught by a variety of fishing methods. The most important are handlines, droplines, traps, trawls, shore seines, gill nets and vertical longlines.

Generally, the soft white flesh of lethrinids is considered of excellent culinary quality. In some areas however, the flesh of smaller individuals of certain species is said to have an unpleasant chemical taste and smell. This taste is sometimes described as 'coppery' or similar to iodine and is thought to be the result of diet on particular invertebrates. In addition, some species in the South and Central Pacific are reported as ciguatoxic at certain times and localities.

Lethrinids are generally marketed fresh.

Copyrighted material

Table 4

Reported catch in metric tons and percent of total catch of emperors and large-eye breams by country for 1987; if in the top four, rank of importance among all species reported

	Catch (mt)	Percent Catch	Rank
Western Central Pacific and Eastern Indian Ocean			
Fiji	2 870	8%	(4)
Hong Kong	954	<1%	
Indonesia	14 000	<1%	
Kiribati	1 620	4%	
Malaysia	44	<1%	
Western Indian Ocean			
Bahrain	930	12%	(4)
Kenya	666	<1%	
Mauritius	5 552	31%	(1)
Oman	1 006	<1%	
Qatar	672	25%	(1)
Saudi Arabia	7 700	17%	(2)
Seychelles	308	8%	
Tanzania	9 500	3%	
United Arab Emirates	7 951	9%	(2)
Yemen Arab Republic	3 000	14%	(2)

1.3 Illustrated Glossary of Technical Terms and Measurements

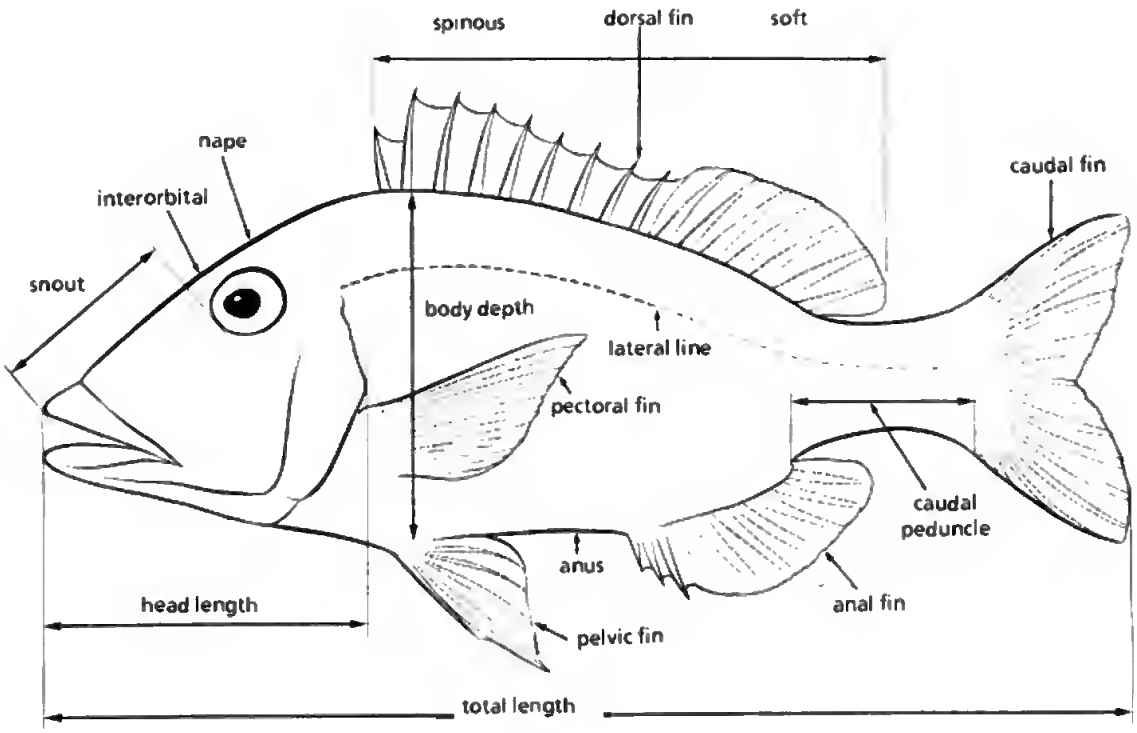


Fig.4 External morphology and measurements

Angle of snout relative to upper jaw - This angle is measured by placing a clear protractor on the snout of the fish with the lower plane bisecting the premaxilla, parallel to the lower line of the premaxilla, with the point of the line resting on the tip of the snout; the upper plane is taken from the tip of the snout and running along a line over the anterior profile of the snout (Fig. 5).

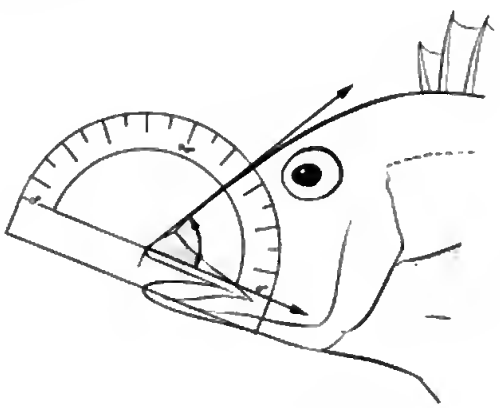


Fig. 5 Angle of snout relating to upper jaw

Anal fin base - The anal fin base is measured from the front base of the anterior-most anal spine to the posterior base of the last anal ray (Fig. 6).

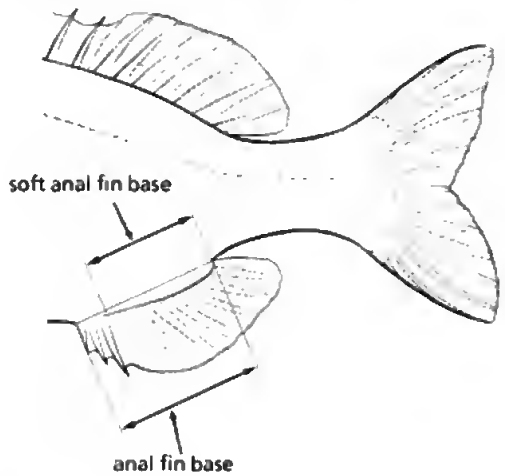


Fig. 6 Length of soft anal fin base and of entire anal fin base

Axil - The angular region between the pectoral fin and the body (Fig. 7).

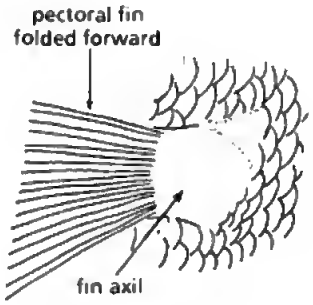


Fig. 7 Pectoral fin axil

Canine - A prominent elongate, sharp tooth. In lethrinids, canines are usually restricted to the front part of the jaws (Fig 8)

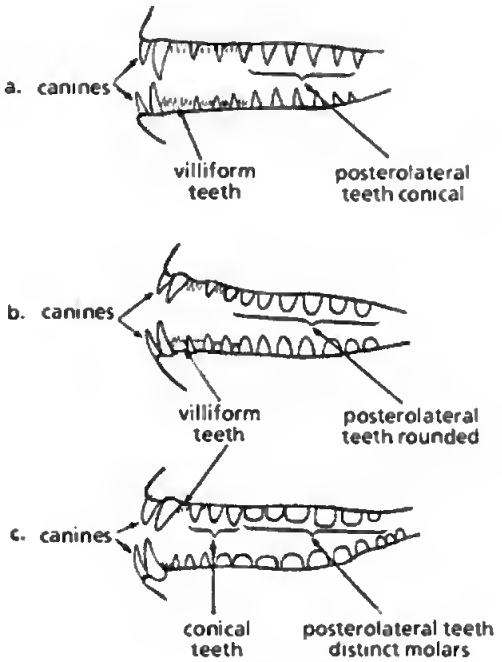


Fig. 8 Types of teeth

Carnivore - A flesh-eating animal.

Caudal peduncle - The narrow end of the body between the posterior basal ends of the dorsal and anal fins and the base of the caudal fin (Fig. 4)

Cheek, Cheek height, Cheek scales - The area between the lower part of the eye and the lower limb of the preopercle. The measurement of cheek height is taken from the lower-most point on the orbit to the furthest point on the angle of the preopercle (Fig. 9). Species of the genus ***Lethrinus*** have naked cheeks, while other lethrinids possess 4 to 6 vertical rows of scales (Fig. 10).

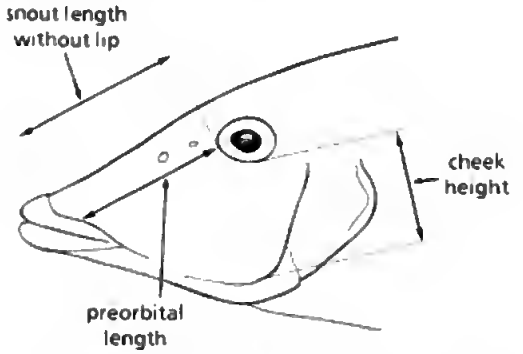


Fig. 9 Measurement of cheek and snout (without lip)

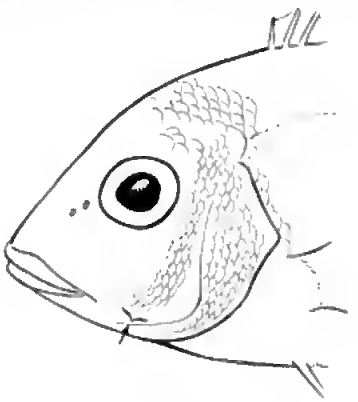


Fig. 10 Rows of scales on cheek

Compressed - Flattened from side to side; refers to relative body width.

Conical - Cone-shaped; refers to teeth (Fig. 8a,c)

Denticulate - Having the appearence of teeth or teeth-like structures (Fig. 13a)

Dorsal - Toward the back or upper part of the body.

Dorsal fin - A median fin along the back. In lethrinids, the fin is supported by spinous rays anteriorly and soft rays posteriorly (Fig. 4)

Edentate - Without teeth

Interorbital - The region of the head above and between the eyes. In lethrinids, this region can be either concave, nearly flat, or convex (Fig. 11).

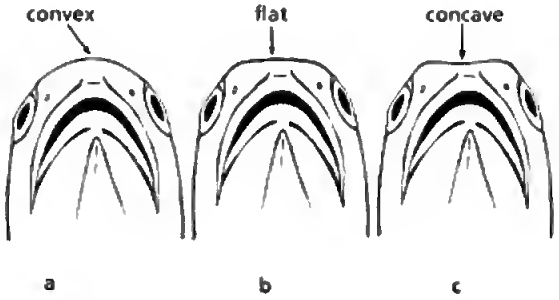


Fig. 11 Anterior view of head showing shape of interorbital region

Lateral line - A series of pored or tubed scales forming a raised line along the side of the body (Fig. 4). The lateral-line scales are counted from the most anterior pored scale near the upper end of the operculum to the base of the caudal fin which is detected by the crease which results from folding the fin forward. There are often one or more tubed scales that continue onto the caudal fin, posterior to the base of the caudal fin; these scales are not included in the count of lateral-line scales.

Lateral teeth - Teeth in the sides of the jaws, observed by opening the mouth and parting the lips (Fig. 8).

Maxilla - The bone of the upper jaw lying above the premaxilla (Fig. 12). The outside surface of the maxilla in lethrinids can be either relatively smooth, or have either a denticulated ridge (Fig. 13a), a simple ridge (Fig. 13b) or a distinctive knob (Fig. 13c). The presence of these structures can be determined in lethrinids by pulling the upper jaw forward so that it protrudes and running the side of a probe over the surface of the maxilla, in a backward direction, and top to bottom to feel the contours of the surface.

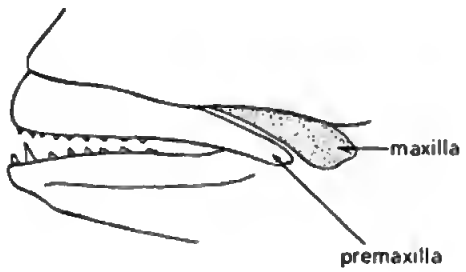


Fig. 12 Bones in upper jaw: maxilla and premaxilla (Maxilla usually covered when mouth is closed, shown here with overlying bone removed)

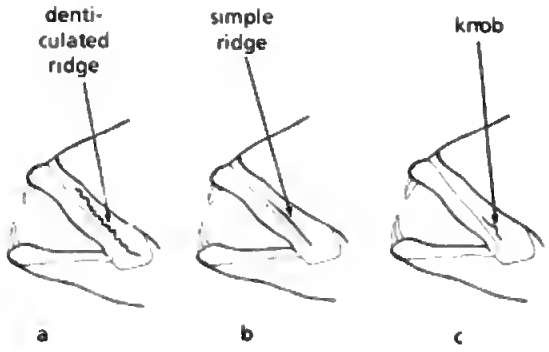


Fig. 13 Outer surface of maxilla (lateral teeth not shown)

Molars, Molariform - Low, broad and rounded teeth; shaped like molars (Fig. 8c).

Naked - Without scales.

Nape - The region of the head where the skull joins the body (Fig. 4).

Opercle - The large bone forming the upper posterior part of the gill cover (Fig. 14).

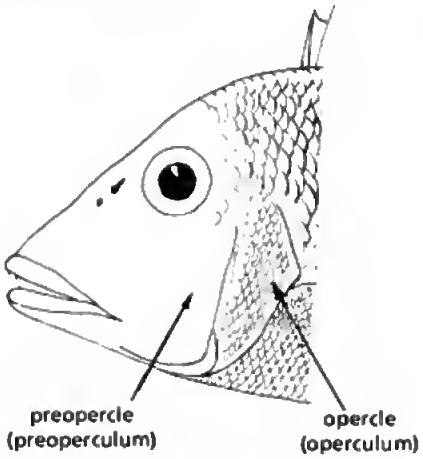


Fig. 14 Lateral view of head

Orbit - The bony border surrounding the eye. Measurements or distances which involve the orbit do not include the fleshy rim of the orbit. It is sometimes necessary to slightly squeeze the rim of the orbit to exclude this fleshy portion.

Palate - The roof of the upper jaw which includes the palatine and vomer bones. These bones bear teeth in many fishes but they are edentate in lethrinids.

Parietal scales - An isolated patch of scales above and behind the eye on the nape, the same as the supra-temporal patch of scales (Fig. 15).

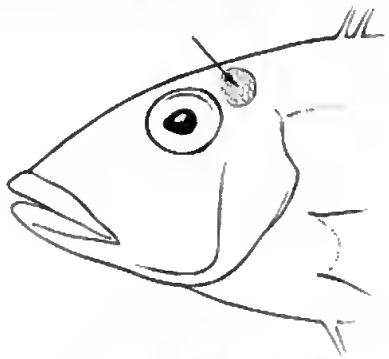


Fig. 15 Location of parietal or supratemporal patch of scales

Peduncular scales - Scales found on the caudal peduncle (Fig. 16). The scales in the lower series around the caudal peduncle are counted by starting with, and including, the lateral line scale near the base of the caudal fin, counting all rows below this scale that terminate on the caudal fin, around the ventral most portion of the caudal, while rotating the fish, and counting the scales on the other side of the caudal peduncle, up to and including the lateral line scale on the opposite side where the count began.

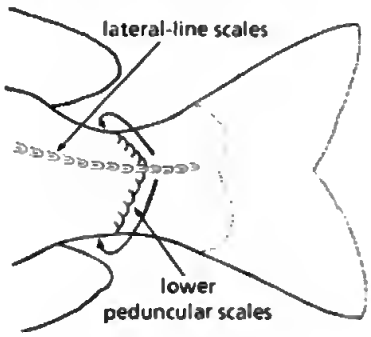


Fig. 16 Scale counts on caudal peduncle

Posterior - The rear or hind portion.

Premaxilla - The anterior bone of the upper jaw (Fig. 12).

Preopercle - Bone on the cheek in front of the opercle and forming the front part of the gill cover (Fig. 14).

Preorbital width - Distance between anterior edge of preorbital bone (can be felt at about midpoint of upper jaw, behind lip) to anterior edge of orbit (Fig. 9).

Rays - The rigid structures that support the fin; soft rays are segmented, and flexible; spinous rays are stiff, unsegmented, and support the anterior portion of the anal and dorsal fins in lethrinids (Fig. 4).

Scales above and below lateral line - A transverse series of scale rows; scales below lateral-line are counted from the origin of the anal fin, not including the median scale row, along a forward diagonal to the lateral line, but not including the lateral line scale; scales above the lateral line are counted from the middle rays of the spinous portion of the dorsal fin (near the base of the fifth or sixth dorsal spine), including the row of small scales at the base of the dorsal fin (this is usually listed as 1/2 a scale), on a diagonal backward to the lateral line, and not including the lateral line row (Fig. 17).

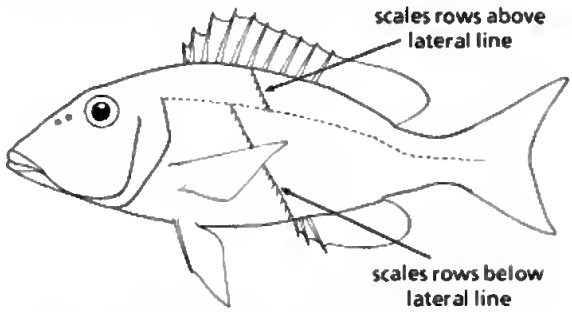


Fig. 17 Scale counts above and below lateral line

Snout - The area between the tip of the upper lip and the anterior margin of the eye (Fig. 4). In lethrinids the snout is often measured without lip (Fig. 9).

Supratemporal patch of scales - Same as the parietal patch of scales (Fig. 15). When counting these scales, all scales in the patch are enumerated, including the small scales often at the lower periphery of the patch.

Transverse series - These are scale rows counted in an oblique series above and below (but not including) the lateral line (Fig. 17). See "Scales above and below the lateral line".

Tubercle - A small bump. Some lethrinids have a small tubercle on the crown of a molariform tooth (Fig. 18).

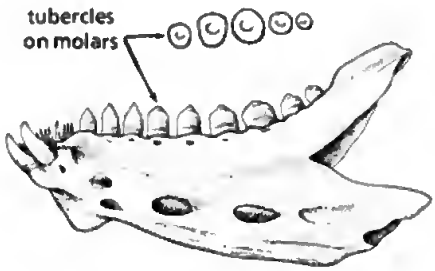


Fig. 18 Lower jaw (left dentary bone)

Villiform teeth - Numerous small slender teeth, usually in a band (Fig. 8).

2. SYSTEMATIC CATALOGUE

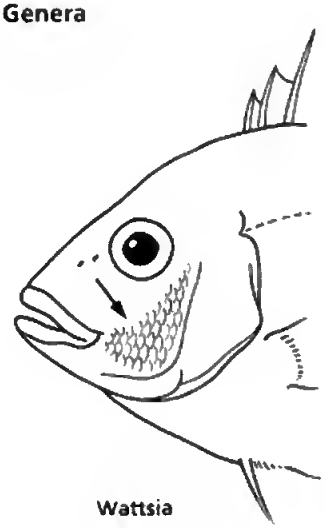
2.1 Diagnostic Features of the Family Lethrinidae

Perchlike sparoid marine coastal fishes of the tropical Indo-West Pacific and West Africa. Dorsal fin continous with 10 spines and nine to 10 soft rays; anal fin with three spines and eight to 10 soft rays; pectoral fin with 13 to 15 soft rays; pelvic fin thoracic, with 1 spine and 5 rays; caudal fin emarginate or forked, with seven to nine procurrent caudal rays. Scales finely ctenoid and moderate in size. Mouth small to moderate, terminal, lips often soft and fleshy; the upper jaw protrusible, the ascending process of the premaxilla confluent with articular process, usually longer than or almost equal to the alveolar ramus; postmaxillary process absent; palato-premaxillary ligament very well developed; maxilla mostly concealed below infraorbital bones, not articulating broadly with the distal tip of the premaxilla, without a supplementary bone; ethmo-maxillary ligament absent; an outer row of canine teeth in front of both jaws, on sides the teeth are conical or molarlike; an inner row of villiform teeth anteriorly; vomer and palatine toothless. Gill membranes broadly united to one another but separated from isthmus; gills four, slit behind the fourth present; pseudobranchs present; gillrakers short and knoblike; four branchiostegal rays inserting on the ceratohyal, the fifth at the interspace between the ceratohyal and the epihyal, the sixth on the epihyal; second epibranchial toothplate present, the third absent. Two openings in pars jugularis; subocular shelf reduced or absent. Three predorsal bones present in the following configuration: first predorsal, first neural spine, second and third predorsal, second neural spine, first pterygiophore supporting the first two dorsal spines and second pterygiophore supporting the third dorsal spine, third neural spine, third pterygiophore supporting fourth dorsal spine, fourth neural spine; two to three trisegmental pterygiophores in the dorsal and anal fins; 11 epipleural ribs; accessory subpelvic keel absent; postpelvic process well developed. Pyloric caeca few, usually 3.

2.2 Illustrated Key to Genera and Species of Monotypic Genera

1a. Cheek with 4 to 6 vertical rows of scales (Fig. 19); 10 soft rays in dorsal fin; usually 9 or 10 soft rays in anal fin

2a. Usually 9 soft rays in anal fin

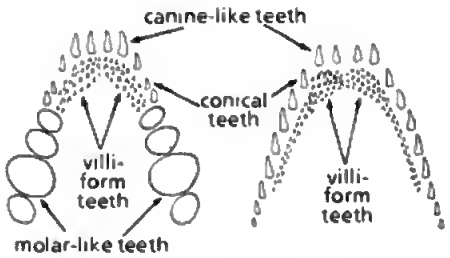


Wattsia

Fig. 19

3a Sides of jaws with round, flat molars preceded by a patch of small teeth and an anterior series of canines (Fig. 20a); profile of head in front of eye strongly convex; pectoral fin with 14 soft rays, inner surface of pectoral fin base scaled (Fig. 21a) no longitudinal stripes on body ..... ***Monotaxis grandoculis*** (Fig. 22, Plate VIII, 47-49)

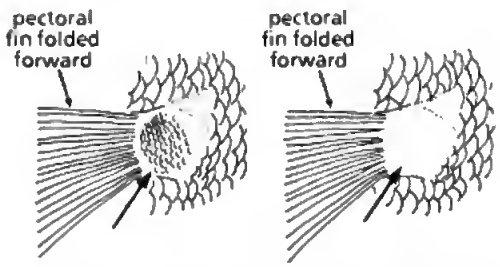
3b. Each jaw with a narrow band of villiform teeth, an outer series of conical teeth, and a series of canines at the front of both jaws (Fig. 20b); profile of head in front of eye slightly convex or straight; pectoral fin with 15 soft rays; inner surface of pectoral fin base scaleless (Fig. 21b); yellow longitudinal stripes on body .... ***Gnathodentex aurolineatus*** (Fig. 23, Plate I, 1)



a. ***Monotaxis*** b. ***Gnathodentex***

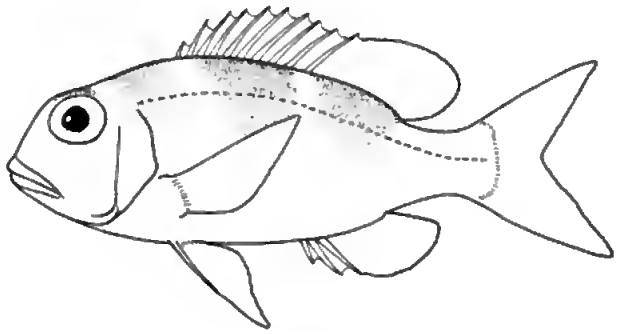
Fig.20

2b Usually 10 soft rays in anal fin

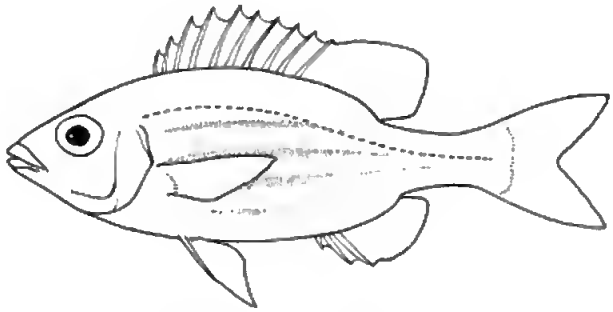


a. scales on inner base b no scales on inner base

Fig. 21



Monotaxis grandoculis **Fig. 22**

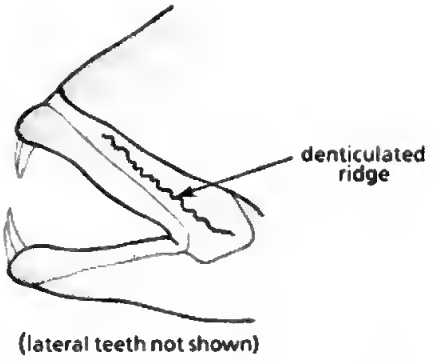


Gnathodentex aurolineatus **Fig. 23**

4a. Maxilla with a strong denticulated longitudinal ridge (Fig 24); caudal fin lobes rounded ..... ***Wattsia mossambica*** (Fig 25, Plate VIII, 50)

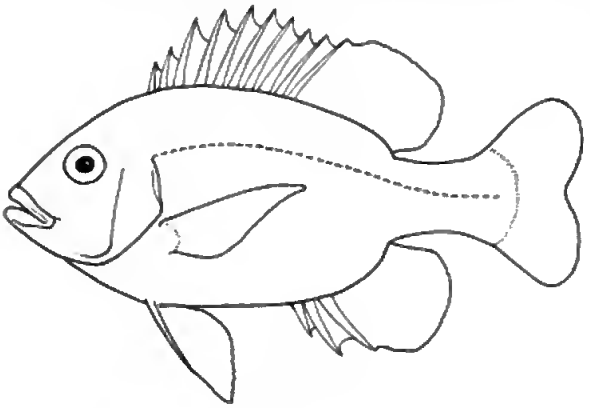
4b. Maxilla surface smooth; caudal fin lobes more or less pointed ..... ***Gymnocranius*** (Fig 26)

1.b Cheek naked (Fig. 27); 9 soft rays in dorsal fin; 8 soft rays in anal fin ..... ***Lethrinus*** (Fig 28)

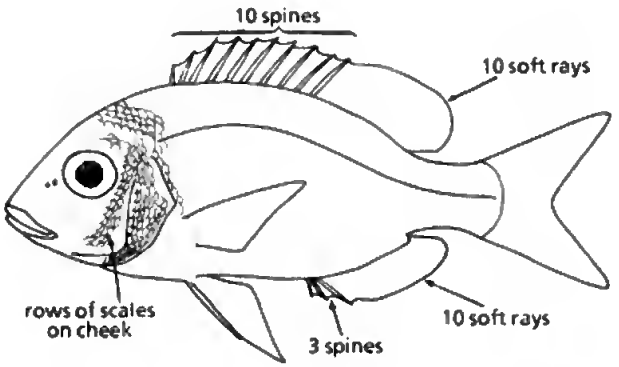


(lateral teeth not shown)

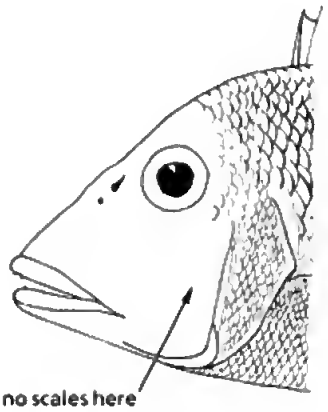
Fig. 24



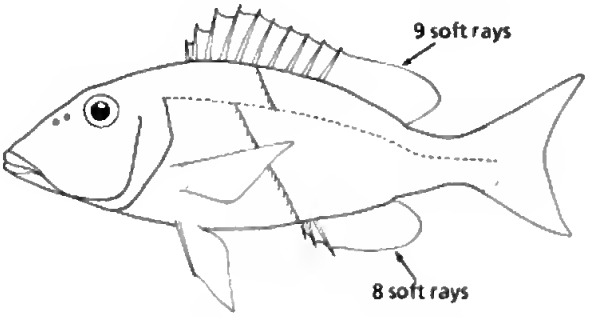
Wattsia mossambica Fig. 25



Gymnocranius Fig. 26



Lethrinus Fig. 27



Lethrinus Fig. 28

2.3 Information by Species

Gnathodentex Bleeker, 1873 | **LETH Gnath**

Genus : ***Gnathodentex*** Bleeker, 1873a: 41. Type-species ***Sparus aurolineatus*** Lacepède, 1803, by original designation.

Synonyms : None, but the single species in the genus has been assigned to ***Dentex, Pentapus***, and ***Pentapodus*** by various authors.

A single species in the genus - see ***Gnathodentex aurolineatus***

Gnathodentex aurolineatus (Lacepède, 1802) Fig. 29, Plate I, 1 | **LETH Gnath 1**

Sparus aureo-lineatus Lacepède, 1802, Histoire nat. poissons, Vol. IV: 42, 132 (no locality given).

Synonyms: ***Dentex lycogenis*** Bennett (1831); ***Gnathodentex ocumaculatus*** Herre (1935).

FAO Names: En - Striped large-eye bream

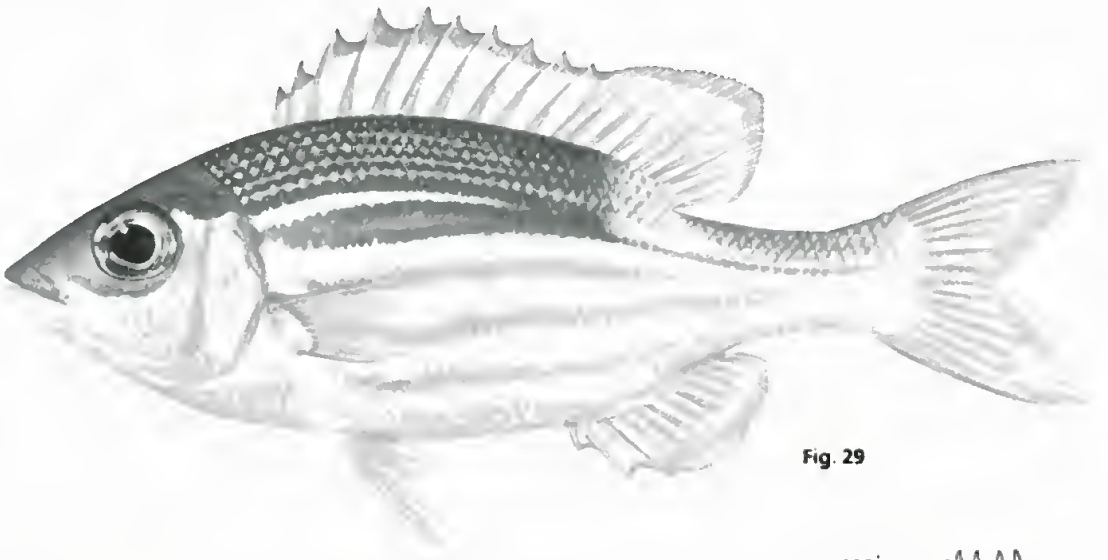
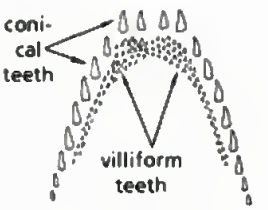


Fig. 29

Diagnostic Features: Body oblong, its depth 2.3 to 2.8 times in standard length. Dorsal profile of head moderately sloped; eye relatively large, its diameter about equal to length of snout; jaw teeth in a narrow villiform band bordered by an outer series of conical teeth; 4 moderate-sized canines at front of upper jaw and 6 at front of lower jaw (Fig. 30); maxilla (upper jaw) with a longitudinal denticulated ridge (Fig. 31); a pair of close-set, round nasal openings on each side of snout in front of eyes. Dorsal fin with 10 slender spines and 10 soft rays, the first to fourth spines increasing in length, the remaining spines about equal; anal fin with 3 slender spines and 8 or 9 (usually 9) soft rays; pectoral rays 15 (including small splint-like uppermost element); caudal fin strongly forked with pointed tips. Lateral-line scales about 68 to 74; 5 scale rows between lateral line and base of middle dorsal fin spines, inner surface of pectoral fin axil scaleless. **Colour**: upper one-third of side (i.e. back region) dark brown with narrow silvery stripes, corresponding with each horizontal scale row; remainder of head and body mainly silver to grey except 4 or 5 brownish-orange stripes on lower two-thirds of side, uppermost stripe is the widest and originates at upper corner of gill flap (operculum); a prominent golden-yellow to orange blotch directly below posterior part of dorsal fin and just in front of caudal fin base; snout and lips often with a yellowish tinge, iris golden; a broad pearly stripe on preorbital region, continuing below eye to its posterior margin; fins mainly clear, although dorsal, anal, and caudal sometimes light reddish; yellow-orange spot at upper base of pectoral fin.



roof of mouth
Fig. 30

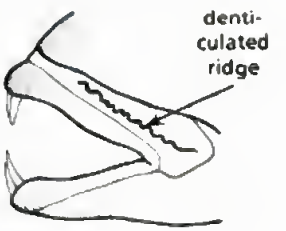


Fig. 31

Copyrighted material

Geogrephical Distribution: Wide-spread in the Indo-west end Central Pacific (excluding the Haweiien Islands) from the Tuamotu Islends to the east coest of Africa, and from Austrelie northwerds to Jepan (Fig. 32).

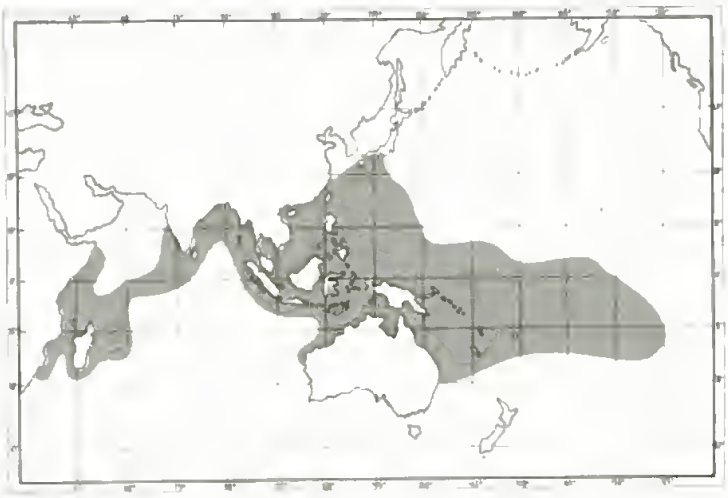


Fig. 32

Habitat end Biology: Generelly found on corel reefs, sometimes in eggregations conteining one hundred or more individuals. The depth range is between about 3 and 20 m. Feeds chiefly on bottom-living invertebretes

Size: Maximum total length about 30 cm; common to 20 cm.

Interest to Fisheries: Frequently found in markets. Caught mainly with spears, treps, gillnets, and handlines. Average quality flesh that is marketed mostly fresh.

Local Names: AUSTRALIA: Gold-lined sea bream; JAPAN: Nokogiridei; LACCADIVE ISLANDS: Bondu (Minicoy), Cheekkani (other islands); NEW CALEDONIA: Perche a lignes d'or; PAPUA NEW GUINEA: Menehale (Port Moresby); PHILIPPINES: Gepas-gapas (Visayen); SEYCHELLES: Carandine; SOUTH AFRICA: Glowfish; TAHITI: Maene.

Litereture: Fischer & Bianchi (eds) (1984); Masuda et al. (1984); Sato (1986); Smith & Heemstre (eds) (1986).

Gymnocranius Klunzinger, 1870

LETH Gymno

Genus: ***Gymnocranius*** Klunzinger, 1870: 764. Type species ***Dentex rivulatus*** Rüppell, 1838 (= ***Cantharus grandoculis*** Valenciennes, 1830 - see remerks below), by monotypy.

Synonyms: Genus ***Paradentex*** Bleeker, 1876.

Diagnostic Feetures: Medium to large-sized emperors with an ovate, leterelly compressed body. Profile of head in front of eye convex, the snout slope relatively steep; adult specimens often developing e bony ridge on nepe end bony shelf above anterior part of eye. Mouth small, usually not reaching to level of eye; each jaw with 2 or 3 small, slender canines at front with remaining teeth villiform, except conical (molariform in one species) on outer part of lateral section. Eye relatively large, a pair of close-set, round nasal openings on each side of snout in front of eyes, usuelly e thin flep of skin on reer edge of enterior opening. Dorsal fin continuous, not noticeably incised in middle portion, with 10 spines end 10 soft rays; enal fin with 3 spines end 10 (occesionelly 9) soft reys; pectoral fin rays 14, including slender, splint-like uppermost element; caudel fin strongly to moderately forked, usuelly with pointed tips. Lateral-line scales 46 to 49 with 2 to 4 additional tubed scales extending on to base of caudal fin; rear part of cheek with 3 to 5 transverse scale rows, remainder of cheek, preorbital, snout, and interorbital scaleless; inner surface of pectoral fin base scaleless. **Colour**: generally overall silvery; cheek region below eye marked with either a dark bar (sometimes faint), wavy blue, longitudinel lines, or numerous blue spots; fins cleer to yellow or reddish. Freshly caught specimens, especially juveniles, often assume e pattern of 5 to 8 narrow derk bars.

Biology, Habitat end Distribution: Inhebits shallow to moderetely deep weter (between ebout 10 end 80 m), usually over sand or rubble bottoms of continental coasts, but a few species are sometimes found around islands or offshore reefs. They generally occur solitarily, but *G. **griseus*** sometimes forms schools. The diet consists of smell, bottom-living invertebrates, especially gastropod molluscs.

Geographical Distribution: Tropicel Indien Ocean to western and central Pacific Ocean.

Interest to Fisheries: Most are caught in relatively low numbers, except *G. **griseus*** which is en important commerciel fish in some countries of southeast Asie such as Malaysia and Thailand. In 1987, Hong Kong reported the cetch of 954 t and Fiji of 223 t of unidentified ***Gymnocrenius*** species.

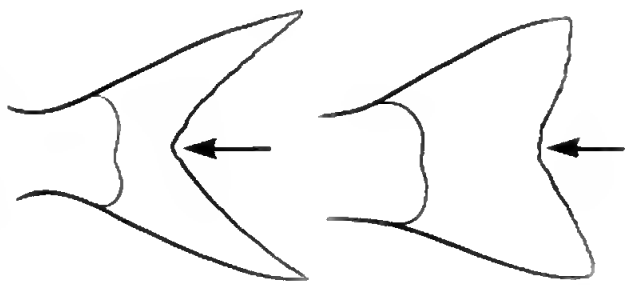
Remarks: The original denomination of the type species, ***Dentex rivulatus*** Ruppell (1838) is an invalid name for the Indo-Pacific species. It is preoccupied by ***Dentex rivulatus*** Bennett (1835), a sparid fish from the Black Sea. ***Gymnocranius grandoculis*** (Valenciennes, 1830) is the valid name for the species described by Ruppell.

The identity of the species in this genus has caused considerable confusion. The main reason for this problem is the great similarity in shape and coloration among the species. In addition, traditional characters such as fin-ray and scale counts, dentition, etc. are of little value. It has been especially difficult to resolve nomenclatorial problems, because of the small size and poor condition of many of the type specimens. Surprisingly, the group is not very well represented in museum collections. Further study of large juvenile to adult series of fresh material is required to confirm the status of most of the species recognized in this catalogue. Therefore the classification presented here should be regarded as provisional.

Key to the species of *Gymnocranius*

1a. Caudal fin strongly forked (Fig. 33a), the median rays shorter than eye diameter; lower edge of eye intersected by line from tip of snout to middle of caudal fin fork (Fig. 34) ..... ***G. elongatus*** (Fig. 35, Plate I, 3)

1b. Caudal fin moderately forked (Fig. 33b), the median rays about equal to, or longer than eye diameter; lower edge of eye above line from tip of snout to middle of caudal fin fork (Fig. 36)



a b **Fig. 33**

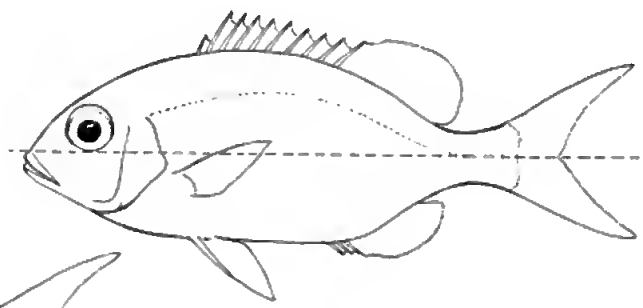
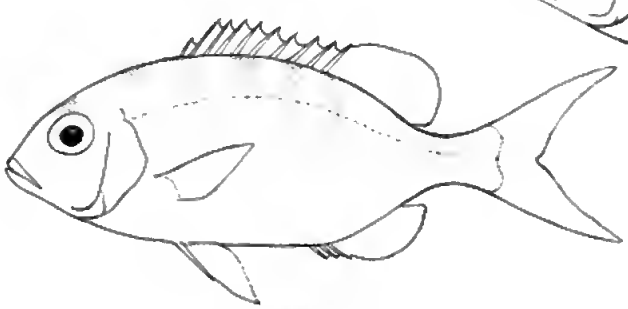


Fig. 34



G. elongatus **Fig. 35**

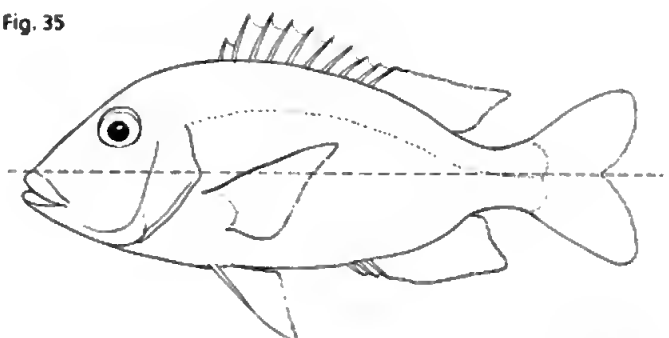


Fig. 36

2a. Longitudinal scale rows between lateral line and base of middle dorsal spines 4½; molars present on sides of jaws (Fig 37a) ....*G. euanus*
(Fig 38, Plate I, 4)

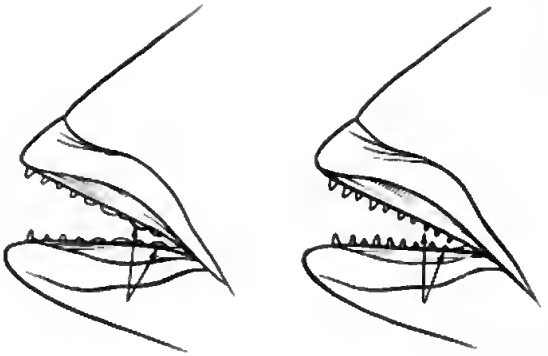
2b. Longitudinal scale rows between lateral line and base of middle dorsal spines 5 1/2 (Fig 39); molars absent, usually villiform to conical teeth present on sides of jaws (Fig. 37b)

3a. Head with a prominent diamond-shaped, blackish patch of scales surrounded by a white border above and behind each eye ..... *G. audleyi*
(Fig. 39, Plate I, 2)

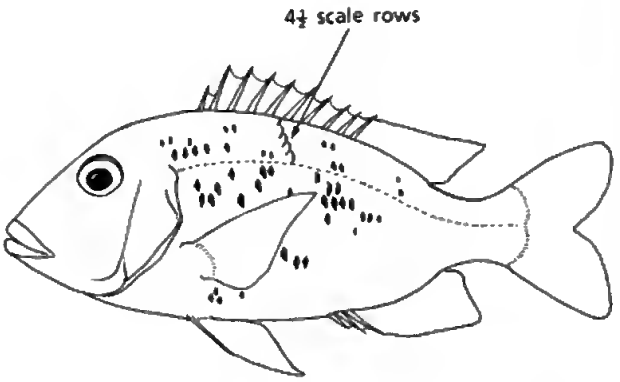
3b. Head without the marking described in 3a

4a. Snout with prominent blue-edged yellow band from front of eye to above upper lip (encompassing nostrils); 3 or 4 oblique, blue (brown in preservative) lines across cheek; body moderately deep, the maximum depth about 2.3 to 2 4 times in standard length .... *G. frenatus*
(Fig. 40, Plate I, 5)

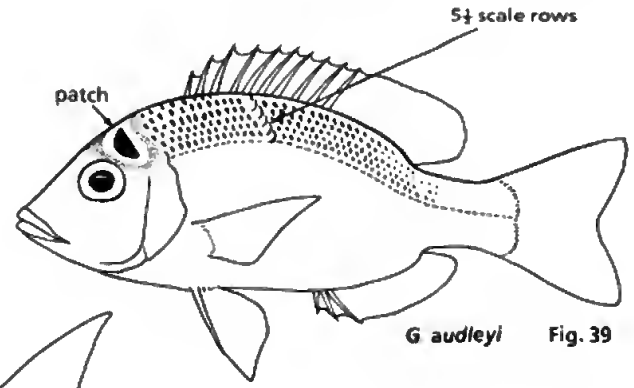
4b. Snout without the marking described in 4 a; cheek may have wavy, blue lines, but they are more or less horizontal rather than oblique; body depth variable, 1.9 to 3.0 times in standard length



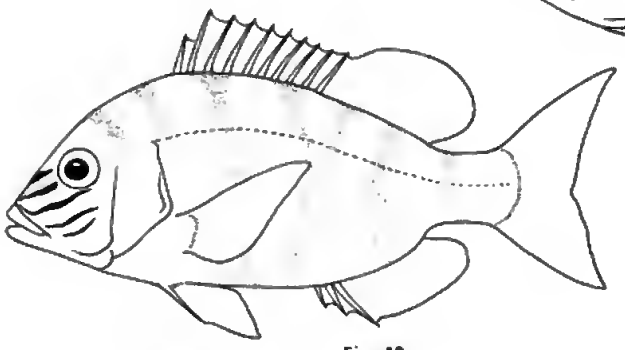
a b Fig. 37



G. euanus Fig. 38



G audleyi Fig. 39



G. frenatus Fig. 40

5a. Inner edge of caudal fin fork slightly convex with fin tips blunt (Fig 41a); live fish with longitudinal rows of dark spots on upper side ..... ***Gymnocranius*** sp
(Fig. 42, Plate II, 10)

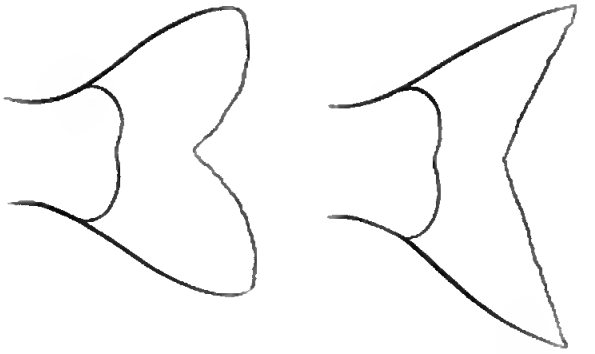
5b. Inner edge of caudal fin fork straight and fin tips pointed (Fig. 41b); no longitudinal rows of dark spots on upper side

6a. Body relatively deep, the maximum depth about 1 9 to 2 2 (occasionally 2.3) times in standard length; no blue spots or wavy blue lines on cheek; usually with several irregular dark bars on sides and dark subocular bar ..... ***G. griseus***
(Fig 43, Plate II, 7,8)

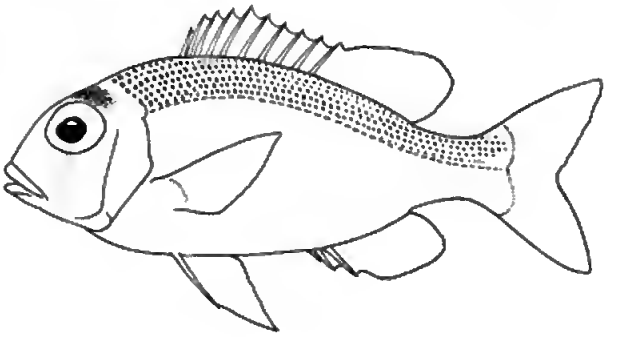
6b. Body relatively slender, the maximum depth about 2.3 to 3.0 times in the standard length; side of snout and cheek often with wavy longitudinal blue lines (Fig. 45) or vertically elongate spots (Fig 44) in fresh specimens longer than 20 to 25 cm standard length; smaller specimens may have irregular dark bars on side and dark subocular bar as in 6a

7a. Maximum depth of body about 2 6 to 3.0 times in standard length; cheek often with vertically elongate blue spots in fresh specimens ... ***G. microdon***
(Fig 44, Plate II, 9)

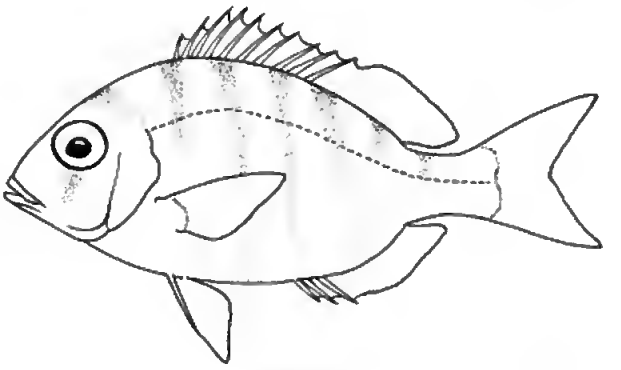
7b. Maximum depth of body about 2.3 to 2.5 (occasionally 2.6) times in standard length; juveniles below about 200 mm standard length frequently with dark bar under eye and 5 or 6 irregular dark bars across side of body adults with wavy, blue lines on snout and cheek, increasing in number with growth ..... ***G. grandoculis***
(Fig 45, Plate II, 6)



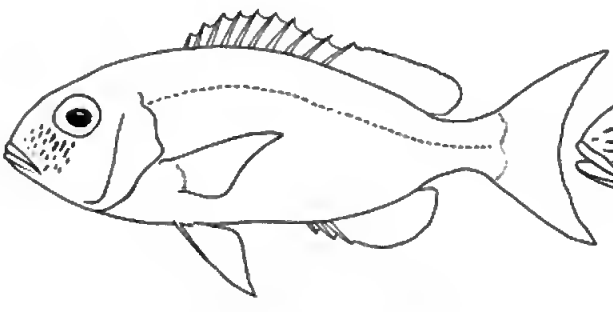
a b Fig. 41



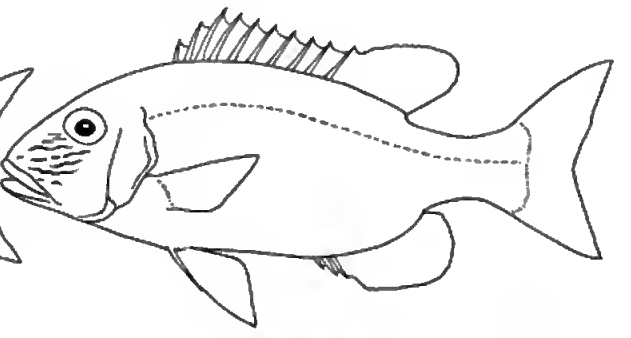
G. sp. Fig. 42



G. griseus Fig. 43



G. microdon Fig. 44



G. grandoculis Fig. 45

Gymnocranius audleyi Ogilby, 1916 Fig 46, Plate I, 2 **LETH Gymno 3**

Gymnocranius audlayi Ogilby, 1916 Mem.Queensland Mus., 5:56 (Moraton Bay, Queensland).

Synonyms: **_Gymnocranius bitorquatus_** Cockerell (1916)

FAO Names: En - Collarad larga-aye bream.

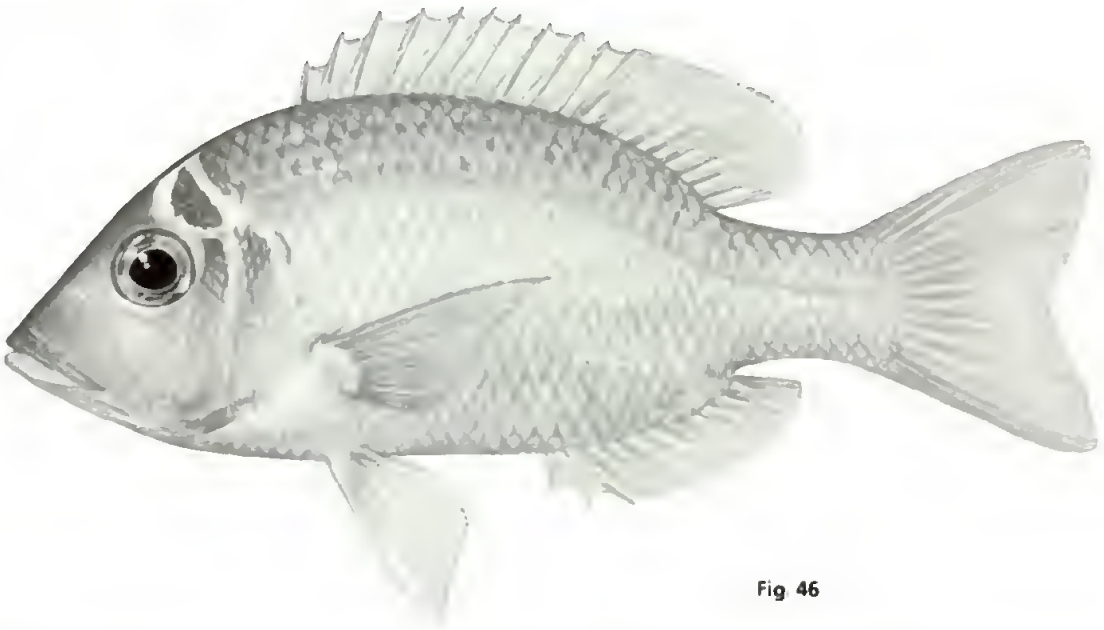


Fig 46

Diagnostic Faatures: Body oblong, its depth 2.2 to 2.4 times in standard length. Snout profile relatively steep, a bony mid-dorsal ridge on nape of adults; lower edge of eye well above a line from snout tip to middle of caudal fin fork; eye relatively large, its diameter usually less than snout length; interorbital space flattened to slightly convax, its width lass than aye diameter; suborbital space about equal to eye diametar or slightly less; jaws extending to a vertical through nostrils; a pair of small, slender canines at front of each jaw; lateral teath villiform (small and slendar) with a few largar outar conical teeth. Dorsal fin with 10 slender spines and 10 soft rays; first 3 or 4 spines gradually increasing in length, the ramainder about equal, tha middla soft rays of dorsal and anal fins slightly elevatad; anal fin with 3 slender spines and 9 or 10 soft rays; pectoral rays 14; caudal fin only modarataly forked with pointed tips, tha median rays longar than aya diamatar Lataral-lina scalas 48 plus 2 tubed scalas axtanding on to base of caudal fin; chaek with 4 or 5 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surfaca of pectoral fin scaleless. **Colour:** ovarall silver or whitish, oftan light brown or oliva on upper sides; each scale on sides with a brown spot forming longitudinal rows, those on back darkest; top of head dull brownish or grey; cheek and opercla silvary, somatimes with a golden sheen; pariatal scala patch (on sida of nape, above and behind aya) blackish surroundad by a brilliant white margin; fins uniformly claar to slightly yallowish. Some individuals, especially those freshly daad, have scattered brown flecks on sides. Also a blackish bar running through the eye may be evidant.

Geographical Distribution: East coast of southarn Queensland, Australia. Also occurs on tha southern half of the Great Barrier Reef (Fig 47).

Fig 47

Copyrighted material

Habitat and Biology: Inhabits sand or rubble areas adjacent to reefs, usually at depths between about 8 to 40 m. It feeds mainly on bottom-living invertebrates.

Size: Maximum total length about 40 cm; common to 35 cm.

Interest to Fisheries: Occasionally seen in markets, although not a high-priority commercial fish. According to Grant (1982) it sometimes has a distasteful iodine flavour that can actually be smelled on freshly hooked fish. However "untainted" fish are good eating.

Local Names: AUSTRALIA: Collared sea bream (or Iodine sea bream).

Literature: Fowler (1933); Grant (1982)

Remarks : The name ***bitorquatus*** has been applied to this species, particularly by Australian authors. It was introduced by Cockerell (1916) in a key to Queensland Sparidae based on scale characteristics, and was not accompanied by a description in the true sense. Cockerell attributed authorship of the species to Ogilby, but the name was not published previously. It is doubtful that the scale characters presented in Cockerell's key are sufficient to constitute a formal description. Both Cockerell's introduction of ***G. bitorquatus*** and Ogilby's description of ***G. audleyi*** were puolished in Mems. Queensland Musuem, Vol. 5 (10 July 1916). Therefore as first revisers of this group we give precedence to ***audleyi***, in the event that the scale characters are interpreted to constitute a valid description (see Article 24a, International Code of Zoological Nomenclature).

Gymnocranius elongatus Senta, 1973

Fig. 48, Plate I, 3

LETH Gymno 4

Gymnocranius elongatus Senta, 1973, Japan. J. Ichthyol., 20 (3):135-144 (South China Sea).

Synonyms: None

FAO Names: En - Forktail large-eye bream

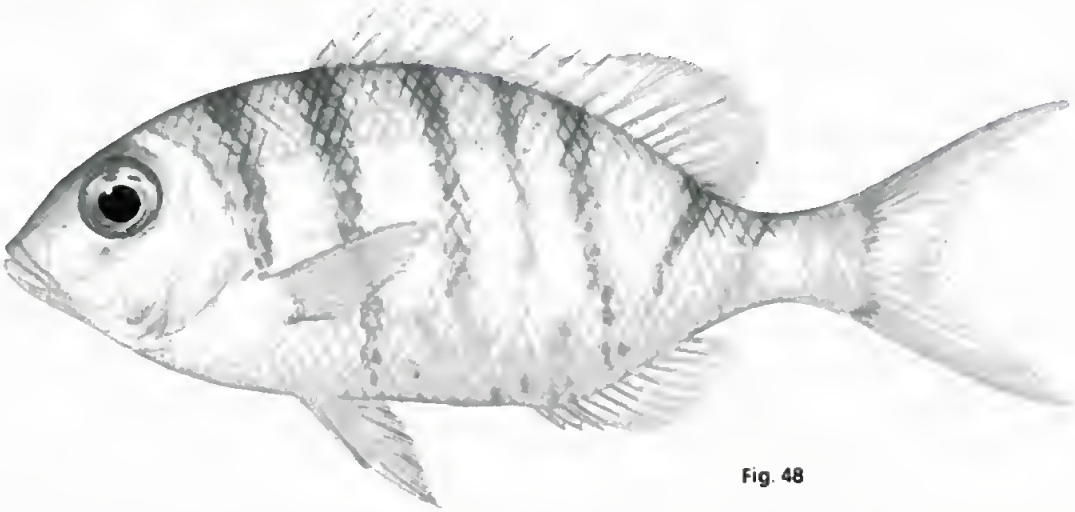


Fig. 48

Diagnostic Features: Body oblong, its depth 2.2 to 2.4 times in standard length. Head profile evenly rounded, snout somewhat pointed; lower edge of eye intersected by line from snout tip to middle of caudal fin fork; eye large, its diameter usually about equal to length of snout; interorbital space convex, about equal to eye diameter; preorbital width less than eye diameter; mouth relatively small, posteriormost part of jaws not reaching a vertical through front of eye; 2 or 3 pair of small, slender canines at front of each jaw, lateral teeth villiform to conical; a pair of close-set, round nasal openings on each side of snout in front of eyes. Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin deeply forked with pointed tips, the median rays shorter than eye diameter. Lateral-line scales 46 to 48 plus 2 to 4 tubed scales extending on to base of caudal fin; cheek with 4 to 6 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** overall silvery, sometimes slightly brownish dorsally; about 8 transverse brown bars on sides, the first crossing through eye, the remainder below dorsal fin and across caudal peduncle; scattered blotches and speckling sometimes evident on sides; fins clear to yellow-orange; caudal margin and tips often deep red. There is considerable variation in the intensity of the dark bars on the sides of the body.

Geographical Distribution: Coastal and shelf waters of the western Pacific and eastern Indian oceans from Japan to northern Australia (Fig. 49). It has also been reported from the western Indian Ocean, but this needs to be confirmed.

Habitat and Biology: Inhabits trawling grounds of the continental shelf, usually at depths between about 50 and 100 m. It feeds mainly on bottom-living invertebrates.

Size: Maximum total length about 35 cm; common to 25 cm.

Interest to Fisheries: Occasionally seen in markets, mainly fresh. Caught mainly with bottom trawls.

Local Names: AUSTRALIA: Swallowtail sea bream; JAPAN: Onaga-meichidai.

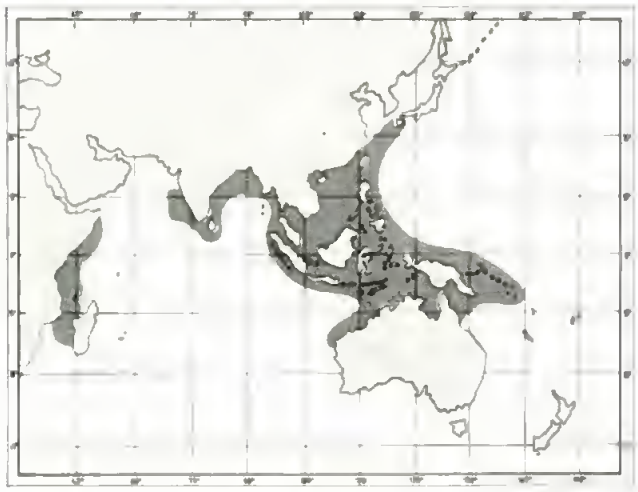


Fig. 49

Literature: Kyushin et al. (1982); Masuda et al. (1984); Gloerfelt-Tarp & Kailola (1984); Sainsbury et al. (1985); Sato (1986); Allen & Swainston (1988).

Gymnocranius euanus Günther, 1879

Fig. 50, Plate I, 4

LETH Gymno 5

Gymnocranius euanus Günther, 1879, Ann. Mag. Nat. Hist., Ser. V, 4:136-137 (Friendly Islands).

Synonyms: ***Monotaxis affinis*** Whitley (1943); ***Gymnocranius japonicus*** Akazaki (1961).

FAO Names: En - Japanese large-eye bream

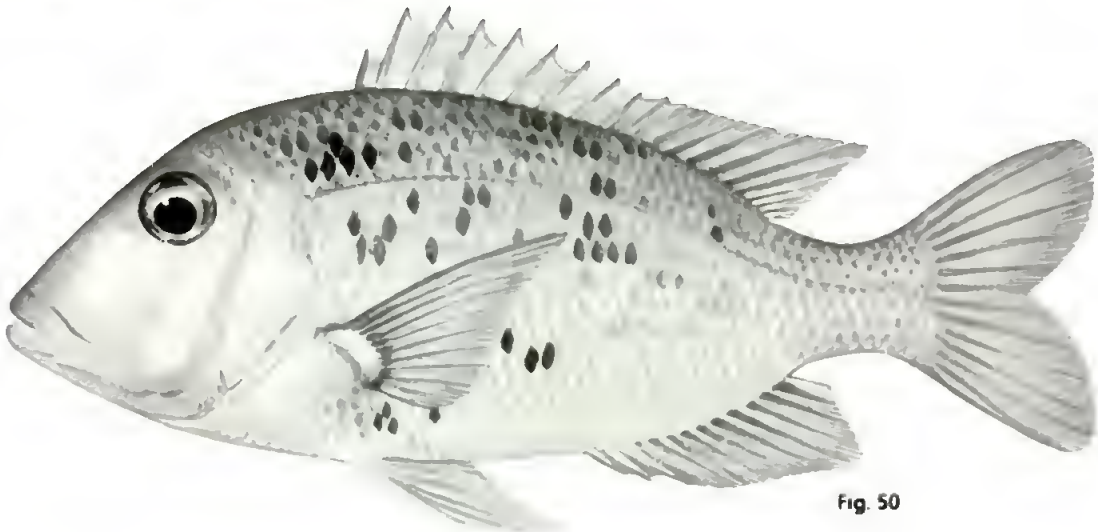


Fig. 50

Diagnostic Features: Body oblong, its depth 2.4 to 2.5 times in standard length. Dorsal profile of head sloping steeply; lower edge of eye well above a line from tip of snout to middle of caudel fin fork; eye relatively large, although its diameter less than interorbital space end width of preorbitel width (et least in adults); mouth reletively smell, posterior part of jaws reeching to ebout level of nostril openings; 2 or 3 pairs of small, slender canines at front of each jaw, other teeth villiform, but well developed molars on lateral sections of jaws. Dorsal fin with 10 slender spines end 10 soft reys; anel fin with 3 slender spines end 10 soft reys; pectorel reys 14; ceudal fin moderetely forked, inner edge of fork slightly convex, with blunt tips, the median rays slightly longer than eye diameter. Lateral-line scales 48 or 49 plus 3 or 4 tubed sceles extending on to bese of caudel fin; cheek with 4 or 5 trensverse scele rows; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectorel fin exil scaleless. **Colour:** overall silvery-white to greyish; sceles of back end sides with e smell brownish basal spot; scattered prominent bleck blotches mainly on anterior half of body; e very feint bar sometimes present below eye to lower edge of cheek; fins mainly clear to reddish, caudal sometimes dusky reddish-brown; faint spots may be evident on dorsal, caudal, and anal fins.

Geogrephicel Distribution: Western Pecific Ocean including southern Jepan, South Chine Sea, the Great Barrier Reef of Australia, Coral Sea, New Caledonie end Tonge (Fig. 51).

Habitat end Biology: Inhabits sand end rubble bottoms edjacent to rock and coral reefs, usuelly et depths between 15 and 50 m. It feeds mainly on smell bottom-living gastropod molluscs

Estimetes of asymptotic length ($L_{infinity}$), coefficient of growth (K) end rete of naturel mortality (M) have been made for the populetion in New Caledonia: $L_{infinity}$ = 39.5 mm SL for males and 35.1 mm SL for femeles, K = 0.22 for males end 0.24 for femeles end M = 0.58 for males and 0.42 for femeles.

Size: Maximum total length ebout 45 cm; common to 35 cm.

Interest to Fisheries: Occasionally seen in merkets, usually fresh. Caught mainly with bottom longlines and handlines, sometimes speared.

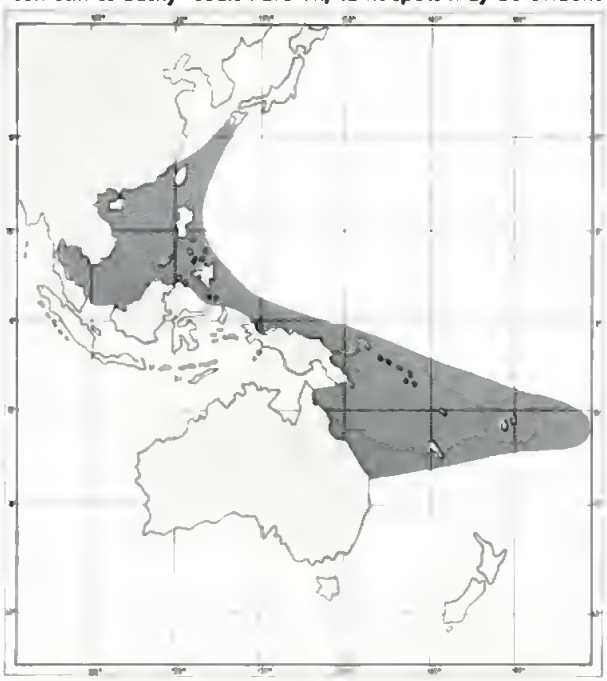


Fig. 51

Local Nemes: AUSTRALIA: Jepanese sea bream; JAPAN: Shirodei; NEW CALEDONIA: Bossu blanc à points noirs.

Literature: Kyushin et al. (1982, as *G. japonicus*); Mesude et al. (1984, as *G. jeponicus*); Sato (1986).

Gymnocranius frenatus Bleeker, 1873 — Fig. 52, Plete I, 5 — **LETH Gymno 6**

Gymnocranius frenatus Bleeker, 1873, Verh.Akad.Amsterdam, 13: 97 (Celebes).

Synonyms: None

Copyrighted material

FAO Names: En - Yellowsnout large-eye bream.

Fig. 52

Diagnostic Features: Body oblong, its depth 2.3 to 2.4 times in standard length. Dorsal profile of head sloping steeply, the upper forehead profile somewhat angular, lower edge of eye well above a line from tip of snout to middle of caudal fin fork in adults; eye relatively large, its diameter slightly greater than interorbital space and preorbital width (at least in adults); mouth relatively small, posterior part of jaws reaching to about level of nostril openings; 2 or 3 pair of small, slender canines at front of upper jaw and an enlarged outward-projecting tusk on each side at front of lower jaw; other teeth villiform, but well developed molars on lateral sections of jaws. Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin moderately forked, inner edge of fork straight, with pointed tips, the median rays longer than eye diameter. Lateral-line scales 48 or 49 plus 3 or 4 tubed scales extending on to base of caudal fin; cheek with 4 or 5 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** overall silvery-white, greyish on upper back; about 5-7 narrow, irregular dark bars (may be very faint) on sides; a prominent blue-edged, yellow band from front of eye to above upper lip, encompassing nostrils; cheek yellowish with 3 or 4 oblique, blue bands sloping upwards from above upper jaw towards rear part of eye; fins mainly clear or whitish; a black spot at base of upper pectoral rays and narrow brown bar across base of entire fin.

Geographical Distribution: Indo-Malaysian Archipelago and South China Sea (Fig. 53).

Habitat and Biology: Inhabits sand, mud, and rubble bottoms, usually at depths between about 20 and 80 m. It feeds mainly on small bottom-living gastropod molluscs.

Size: Maximum total length about 35 cm; common to 30 cm.

Interest to Fisheries: Common in some markets of Malaysia, Thailand, and Vietnam. Usually is fresh or dried-salted. Caught mainly with bottom trawls, but sometimes with bottom longlines and handlines.

Literature: Kyushin et al. (1982, as *G. griseus*).

Fig. 53

Gymnocranius grandoculis (Valenciennes, 1830) Fig 54, Plate II, 6 **LETH Gymno 2**

Cantharus grandoculis Valenciennes in Cuvier & Valenciennes, 1830, Hist. nat. poissons, Vol. 6: 341 (Seychelles).

Synonyms: ***Dentex rivulatus*** Ruppell (1838); ***Dentex lethrinoides*** Bleeker (1851a); ***Pentapus dux*** Valenciennes (1862); ***Pentapus curtus*** Guichenot (1865); ***Dentex robinsoni*** Gilchrist & Thompson (1908); ***Paradentex marshalli*** Whitley (1936); ***Gymnocranius rüppellii*** Smith (1941)

FAO Names: En - Blue-lined large-eye bream

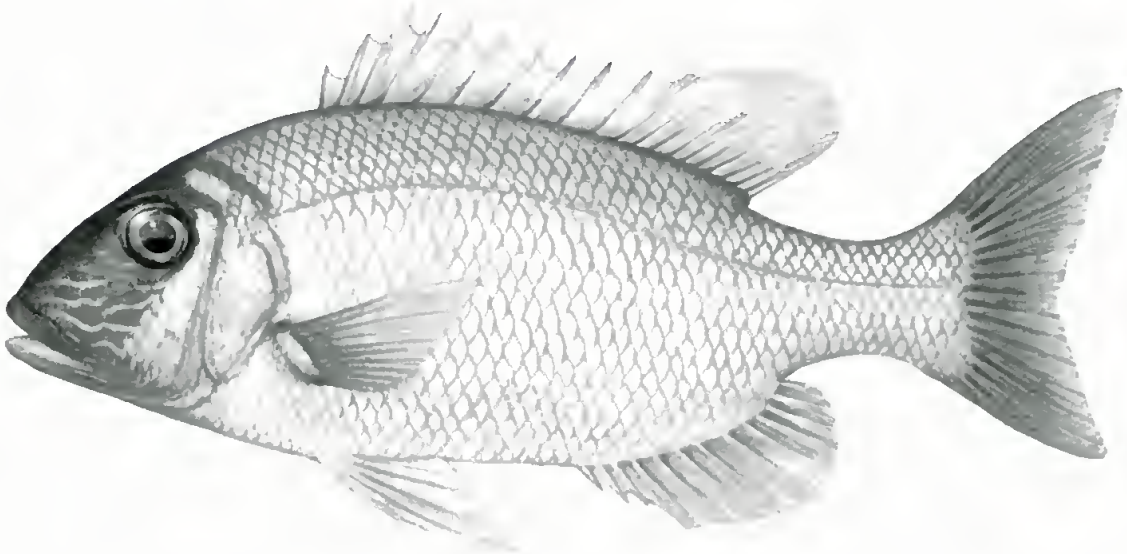


Fig. 54

Diagnostic Features: Body oblong, its depth usually 2.4 to 2.5 times in standard length. Forehead profile moderately steep; large adults developing a bony ridge on nape and bony shelf over front part of eyes; lower edge of eye well above a line from tip of snout to middle of caudal fin fork; eye relatively large, about equal to or larger than interorbital space and preorbital width in small specimens (less than about 40 cm), but much smaller in comparison to interorbital and preorbital widths in large fish; mouth relatively small, posterior part of jaws not reaching a vertical through front of eye; 2 or 3 pairs of slender canines at front of each jaw, although the outer canine on each side of lower jaw is usually enlarged; other teeth villiform, becoming strongly conical on lateral sections of jaws. Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin only moderately forked with pointed tips, the median rays much longer than eye diameter. Lateral-line scales 48 plus 2 or 3 additional tubed scales extending on to base of caudal fin; cheek with 3 or 4 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** overall silvery with thin brown scale margins; anterior half of head often brown; a series of narrow undulating, longitudinal lines on cheek and side of snout; fins clear to yellow or orange; caudal fin frequently dusky grey-brown; a narrow brown bar across base of pectoral fins. Juveniles under about 25 cm standard length often with 5 or 6 irregular dark bars on side and dark bar below eye. The bar at the level of the pectoral fin base is usually the widest and the dark coloration extends onto the pelvic fins.

Copyrighted material

Geographical Distribution: Widely distributed in the Indian Ocean and western edge of the Pacific Ocean, from East Africa to southeastern Oceania and Australia northward to Japan (Fig. 55).

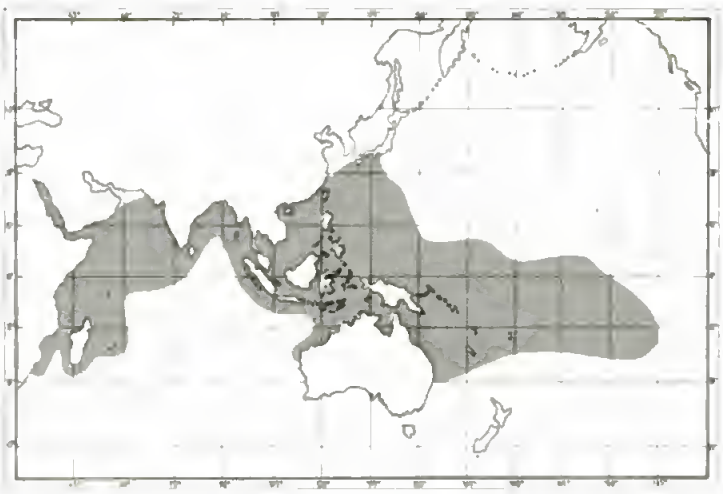


Fig 55

Habitat and Biology: Inhabits trawling grounds of the continental shelf and offshore rocky bottoms, usually at depths between about 50 and 100 m. It feeds mainly on bottom-living invertebrates and small fishes.

Estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K) and natural mortality (M) have been made for the population around New Caledonia: $L_{infinity}$ = 46 4 mm SL, K = 0.23 and M = 0.57

Size: Maximum total length about 80 cm; common to 50 cm.

Interest to Fisheries: Occasionally seen in markets, mainly fresh. Caught mainly with bottom longlines and bottom trawls. A good potential commercial fish if sufficient stocks can be located.

Local Names: AUSTRALIA: Robinson's sea bream; JAPAN: Sazanamidai; NEW CALEDONIA: Bossu blanc grosserace; MADAGASCAR: Bariadiva, Barialava, Tsivaravaramena; SEYCHELLES: Capitaine blanc; SOUTH AFRICA: Rippled barenose of Gerimpelde kaalneus; TANZANIA: Thangu-chaa

Literature: (as ***G. robinsoni***): Kyushin et al. (1977); Fischer & Bianchi (eds.) (1984); Masuda et al. (1984); Kyushin et al. (1982); Sato (1986); Allen & Swainston (1988).

Remarks: This species has been referred to as ***G. robinsoni*** in recent literature.

Gymnocranius griseus (Schlegel, 1844) Fig. 56, Plate II, 7,8 **LETH Gymno 1**

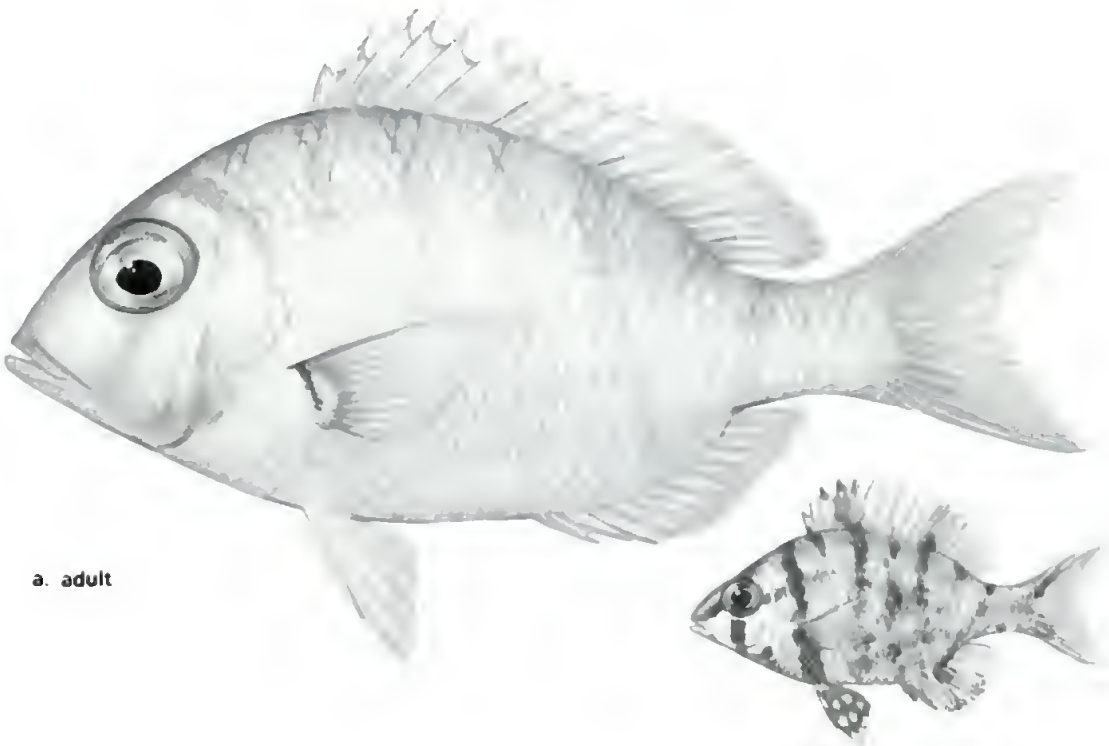
Dentex griseus Schlegel in Temminck & Schlegel, 1844, Fauna Japonica: 72 (Japan).

Synonyms: ***Lobotes microprion*** Bleeker (1851b); ***Gymnocranius orbis*** Fowler (1938)

FAO Nemes: En - Grey large-eye bream.

Diagnostic Features: Body oblong, its depth usually 1.9 to 2.3 times in standard length. Dorsal and ventral profile of head evenly convex or ventral profile slightly straighter; lower edge of eye slightly above a line from tip of snout to middle of caudal fin fork; eye relatively large, its diameter about equal to or slightly larger than preorbital and interorbital widths; mouth relatively small, posterior part of jaws reaching to about level of anterior nostrils. Two or 3 pair of small, slender canines at front of each jaw, other teeth villiform, becoming conical on lateral sections.

Copyrighted material



a. adult

b. juvenile

Fig. 56

Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin moderately forked with pointed tips, the median rays slightly longer than eye diameter. Lateral-line scales 46 to 48 plus 2 or 3 additional tubed scales extending on to base of caudal fin; cheek with 4 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. Colour: overall silvery, frequently with a diffuse to vivid pattern of 5 to 8 narrow dark bars on side, including one through eye and across cheek; fins mainly clear to yellowish, sometimes diffuse mottling or spotting on dorsal, caudal, and anal fins; often a narrow brown bar across bases of pectoral fins. Some adult individuals possess a few scattered blue spots or scribbling on the snout and cheek.

Geographical Distribution: Southern Japan to the Indo-Malaysian region and possibly eastward to India (Fig. 57). The species has often been confused with the young of ***G. grandoculis***, hence the true distributional limits are somewhat obscure. Records of ***G. griseus*** from the Western Indian Ocean probably pertain to ***G. grandoculis***.

Habitat and Biology: Inhabits coastal trawling grounds, usually at depths between about 20 and 80 m. It feeds mainly on bottom-living invertebrates. Sexual maturation occurs at a fairly small size, about 15 to 17 cm standard length.

Size: Maximum total length has been reported at 80 cm, but it is doubtful that the species grows that large; maximum reliable total length is about 35 cm; common to 25 cm.

Fig. 57

Copyrighted material

Interest to Fisheries: Common in markets, mainly fresh, occasionally dried. Caught mainly with bottom trawls, but sometimes with bottom longlines and handlines.

Local Names: AUSTRALIA: Naked-headed sea bream; JAPAN: Meichidai; PHILIPPINES: Gapas-gapas (Visayan); SOUTH AFRICA: Grey barenose or Grys kaalneus

Literature: (as *G. griseus* except as noted): Kyushin et al. (1977); Fischer & Bianchi (eds.) (1984); Masuda et al. (1984); Kyushin et al. (1984, as *Gymnocranius* sp.); Sato (1986); Allen & Swainston (1988).

Remarks: This species is characterised by a relatively deep body in both small juveniles and adults, the depth 1.9 to 2.2 times in standard length. All specimens that were examined, and numerous fish seen at markets on the Gulf of Thailand, had a pattern of 5 to 7 faint bars on the side and a subocular bar. The types were examined at RMNH (Leiden) by Kent Carpenter. The lectotype is a dried specimen (RMNH D2248), 340 mm standard length. Its elongate shape (depth 2.7 in standard length) is perhaps due to distortion. However, there is a possibility that it could represent another species, possibly *G. grandoculis*. The paralectotype (RMNH 1026), 182 mm standard length, has a depth of 2.07 and still shows faint remnants of the barred pattern. ***Lobotes microprion*** Bleeker is apparently a junior synonym. It was described from small juveniles. We have examined 2 syntypes (RMNH 5680, mixed with holotype of ***Dentex lethrinoides***), 51 to 56 mm standard length. They still exhibit faint bars and body depths are 1.96 and 2.03 in the standard length.

Gymnocranius microdon (Bleeker, 1851)

Fig. 5B, Plate II, 9

LETH Gymno 7

Dentex microdon Bleeker, 1851c, Nat. Tijdschr. Ned. Indie, Vol. 2:219 (Celebes)

Synonyms: None

FAO Names: En - Blue-spotted large-eye bream

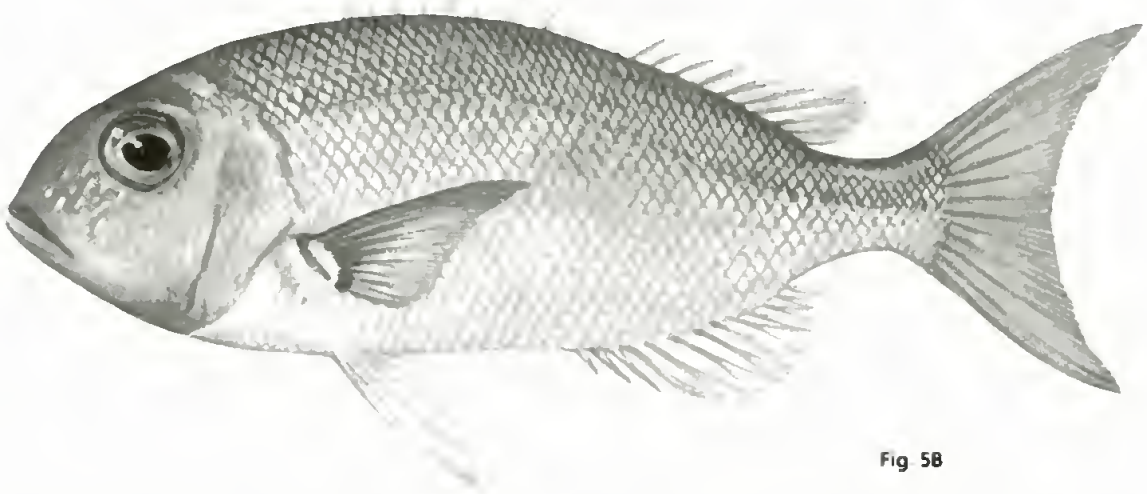


Fig. 5B

Diagnostic Features: Body oblong, its depth 2.5 to 3.0 times in standard length. Forehead profile moderately steep; lower edge of eye well above a line from tip of snout to middle of caudal fin fork; eye large, about equal to width of preorbital and interorbital spaces; mouth relatively small, posterior part of jaws reaching to about level of nostril openings; 2 or 3 pairs of small, slender canines at front of each jaw, other teeth villiform becoming conical on lateral sections of jaws. Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin moderately forked with pointed tips, median rays longer than eye diameter. Lateral-line scales 48 or 49 plus 2 or 3 tubed scales extending on to base of caudal fin; cheek with 3 or 4 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** overall silvery to brownish, scale margins with a narrow brown border; numerous vertically elongate blue spots on snout and cheek, and sometimes on operculum; fins clear to yellow or reddish, caudal sometimes dusky brown.

Geographical Distribution: Known thus far only from southern Japan, the South China Sea, the Marshall Islands, and off Phuket, Thailand in the Andaman Sea (Fig. 59).

Habitat and Biology: Inhabits sand and rubble bottoms adjacent to rock and coral reefs, usually at depths between about 20 and 50 m. It feeds mainly on small bottom-living invertebrates.

Size: Maximum total length about 45 cm; common to 35 cm.

Interest to Fisheries: Occasionally seen in markets, usually fresh. Caught mainly with bottom longlines and handlines

Local Names: JAPAN: Ome-meichidai.

Literature: Kyushin et al. (1982, as *Gymnocranius* sp.); Masuda et al (1984); Sato (1986).

Fig 59

Gymnocranius sp. Fig 60, Plate II, 10 **LETH Gymno 8**

Synonyms: ***Gymnocranius lethrinoides*** (not of Bleeker, 1851a) in Masuda et al. (1984)

FAO Names: En - Blacknape large-eye bream.

Fig 60

Copyrighted material

Diagnostic Features: Body oblong, its depth 2.4 to 2.5 times in standard length. Dorsal profile of head convex, the snout sloping steeply; lower edge of eye well above a line from tip of snout to middle of caudal fin fork; eye large, its diameter about equal to interorbital space and larger than width of preorbital; mouth relatively small, posterior part of jaws reaching to about level of nostril openings; 2 or 3 pairs of small, slender canines at front of each jaw, other teeth villiform, becoming conical on lateral sections of jaws. Dorsal fin with 10 slender spines and 10 soft rays; anal fin with 3 slender spines and 10 soft rays; pectoral rays 14; caudal fin moderately forked, inner edge of fork slightly convex, with blunt tips, the median rays slightly longer than eye diameter. Lateral-line scales 47 or 48 plus 3 or 4 tubed scales extending on to base of caudal fin; cheek with 4 or 5 transverse scale rows; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** Overall silvery or silvery-white; scales of back (and sometimes lower on sides) with a prominent blackish basal spot forming longitudinal rows; area immediately above eye (supraorbital shelf) blackish; a blackish (may be very faint) bar below eye to lower edge of preoperculum; fins mainly clear to reddish, caudal sometimes dusky reddish-brown.

Geographical Distribution: Known only from southern Japan, the Great Barrier Reef of Australia, Coral Sea, and New Caledonia (Fig. 61).

Habitat and Biology: Inhabits sand and rubble bottoms adjacent to rock and coral reefs, usually at depths between 15 and 40 m. It feeds mainly on small bottom-living gastropod molluscs. Sexual maturation is attained by a total length of at least 27 cm.

Estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K) and rate of natural mortality (M) have been made for the population around New Caledonia: $L_{infinity}$ = 37 mm SL, K = 0.28, M = 0.69.

Size: Maximum total length about 45 cm; common to 35 cm.

Interest to Fisheries: Occasionally seen in markets, usually fresh. Caught mainly with bottom longlines and handlines, sometimes speared.

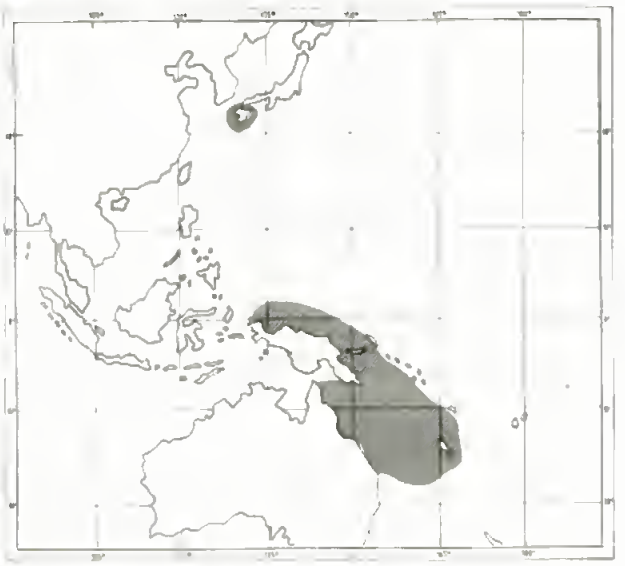


Fig. 61

Local Names: AUSTRALIA: Spotted sea bream; JAPAN: Tama-meichi; NEW CALEDONIA: Bossu blanc à nageoires roses.

Literature: Masuda et al. (1984, as *L. lethrinoides*); Sato (1986).

Remarks: This species appears to be undescribed. It has sometimes been referred to as ***G. lethrinoides***, a synonym of ***G. grandoculis***.

Copyrighted material

Lethrinus Cuvier, 1829

LETH Leth

Genus: ***Lethrinus*** Cuvier, 1829: 184. Type species, ***Sparus choerorynchus*** Bloch & Schneider, 1801 [***L. nebulosus*** (Forsskål, 1775)], by subsequent species designation (Jordan & Thompson, 1912).

Synonyms: Genus ***Lethrinella*** Fowler, 1904; Subgenus ***Lethrinichthys*** Jordan & Thompson, 1912.

Diagnostic Features: Medium to large-sized emperors with an oblong, laterally compressed body. Profile of head in front of eye convex, nearly straight or concave, the snout slope fairly steep or gradual. Mouth size moderate, sometimes reaching to level of anterior orbit; lateral teeth in jaws conical or molariform; outer surface of maxilla with or without a pronounced ridge, or with a knob; ascending process of premaxilla longer than alveolar ramus. Subocular shelf absent; epiotic-pterotic suture broad; vertical sphenotic flange entire. Dorsal fin continous, with 10 spines and 9 soft rays; anal fin with 3 spines and 8 soft rays; pectoral fin with 13 rays; caudal fin strongly to moderately forked, with pointed or rounded lobes. Lateral-line scales 42 to 49, often with 2 additional tubed scales extending onto base of caudal fin; scale rows above lateral line to middle spines at base of dorsal fin 4 1/2 to 5 1/2 (sometimes recorded as 5 or 6 respectively); cheek naked; inner surface of pectoral fin base densely or sparsely scaled, or without scales. **Colour:** body colour silvery, grey, olive, greenish, bluish, tan, brown or reddish, often with dark blotches or bars that can either be persistent or appear and disappear depending on the emotional state of the fish; sometimes bright red markings on or near base of pectoral fin, on pelvic, on anal and dorsal fin membranes near the base of the fin, on opercular and preopercular margins, and on head, these markings often variable within species; fins clear, pale, bluish, yellowish or reddish, often blotched, the edge of fins often reddish.

Biology, Habitat and Distribution: Inhabits coastal waters, often over sandy bottom and including seagrass beds, mangrove swamps, coral reefs, rocky reefs, to depths of 220 m. They usually occur solitary or in small groups and form large aggregations while spawning. The diet consists mostly of echinoderms, crustaceans, molluscs, fish and polychaetes.

Geographical Distribution: Tropical eastern Atlantic, Indian and western Pacific Oceans.

Interest to Fisheries: Moderate to significantly important in fisheries; in certain countries, members of this genus are the most important catch by weight. Caught primarily by handlines, traps, trawls, shore seines and vertical longlines.

Remarks: Some authors separate this genus into ***Lethrinella*** and ***Lethrinus*** based mostly on snout length. Snout length and shape varies widely within the genus however, with many intermediates. We defer recognizing any supraspecific taxa within this group, pending detailed phylogenetic analysis.

Key to the species of *Lethrinus*

Notes on the use of the key : Two of the most useful characters in differentiating species of ***Lethrinus*** are the presence or absence of scales in the axil of the pectoral fin and the number of scale rows above the lateral line to the middle spines of the dorsal fin (Table 5). These characters are relatively constant for most species of ***Lethrinus*** but in a few species they vary widely. Because of this variation, some of the previous keys have tended to de-emphasize the use of these characters. After examining the variation of these characters in many specimens however, we have found that the advantages of using them far outweighs the disadvantages of their variation. The strategy to tolerate this variation has been to treat the variable species early in the key, to have species occur more than once in the key and, to add redundant diagnostic characters. Despite this strategy, the identification of species of ***Lethrinus*** can still be a formidable task. We have added frequency tables of meristic characters that have been included in this key as aids in visualizing the degree of variation within species. These tables are particularly useful for those characters that have not been used in previous keys to the species of ***Lethrinus***, i.e. lateral-line scales (Table 5), scale rows below the lateral line to the origin of the anal fin (Table 6), scales in the supratemporal scale patch (Table 7) and, scale rows in the lower series of scales surrounding the caudal peduncle (Table 6). These tables will help verify an identification when several specimens of a species are available.

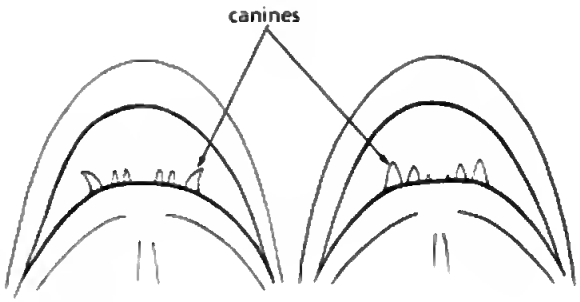
Copyrighted material

1a Second dorsal spine distinctly longer than other dorsal spines; canines of lower jaw substantially curved outward (Fig 62a) and, lateral teeth in jaws conical in adults (Fig 65a) . *L. genivittatus* (Fig 63, Plate IV, 22)

1b. Third, fourth, or fifth dorsal spine the longest; canines in front of lower jaw almost straight or curved backward slightly (Fig 62b) or, if curved outward, the lateral teeth in jaws include strong molars (Fig 65c) (other species with conical, rounded or slightly molariform teeth).

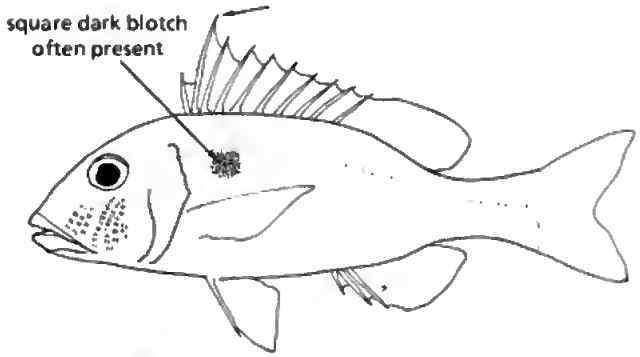
2a. Inner surface of pectoral fin base without scales (Fig 64a) or, with a few scales covering less than 1/2 the inner base of the fin

3a Longitudinal scale rows between lateral line and base of middle dorsal spines 4 1/2*; lateral teeth in jaws conical (Fig 65a)

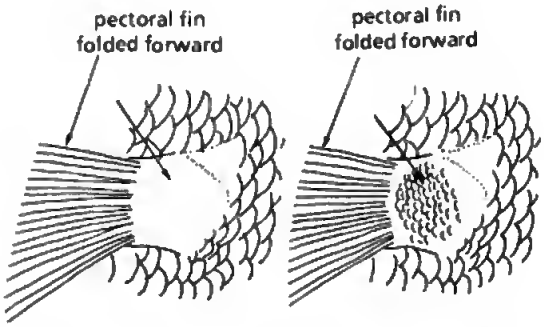


a. L. *genivittatus* b. other *Lethrinus* species

Anterior view of canines in lower jaw (teeth in upper jaw not shown) Fig. 62

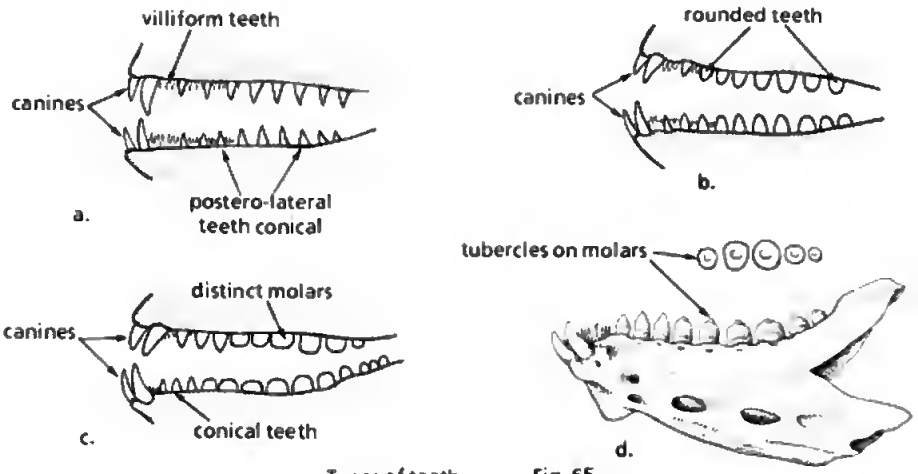


L. *genivittatus* Fig.63



a. no scales on inner base b. scales on inner base

Inner surface of pectoral fin Fig. 64



Types of teeth Fig. 65

* For method of counting scale rows see Glossary of Technical Terms, Fig 17

4a. Head length less than or almost equal to body depth (Figs 66-68)

5a. Found in Atlantic Ocean; 42 to 45 lateral-line scales; 13 or 14 scale rows in lower series around caudal peduncle* ..... ***L. atlanticus***
(Fig 66, Plate III, 13)

5b. Found in the Indo-Pacific region; 47 to 50 lateral-line scales; 15 scale rows in lower series around caudal peduncle*

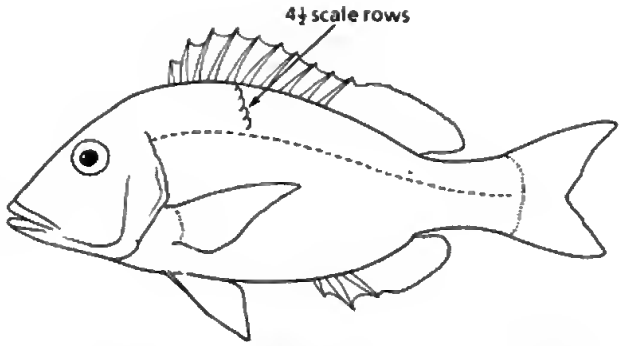
6a. Third dorsal spine usually the longest, its length 2.3 to 2.9 times in body depth; snout profile concave; in life, red markings around eye ..... ***L. miniatus***
(Fig 67, Plate VI, 32-34)

6b. Fourth dorsal spine usually the longest, its length 2.8 to 3.7 times in body depth; snout profile approximately straight or slightly concave; in life, blue markings around eye ..... ***L. haematopterus***
(Fig. 68, Plate IV, 23)

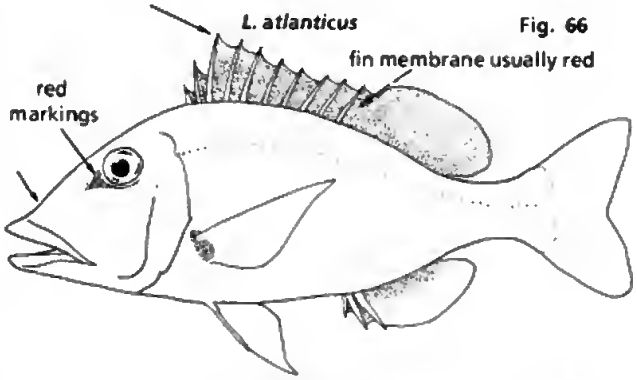
4b. Head length distinctly greater than body depth (Figs 69, 70, 73, 74, 76, 77, 79, 80, 81, 82)

7a. Body very slender, the depth 3.4 to 3.9 times in the standard length; scale rows in transverse series below lateral line 13 or 14** ..... ***L. variegatus***
(Fig. 69, Plate VIII, 45)

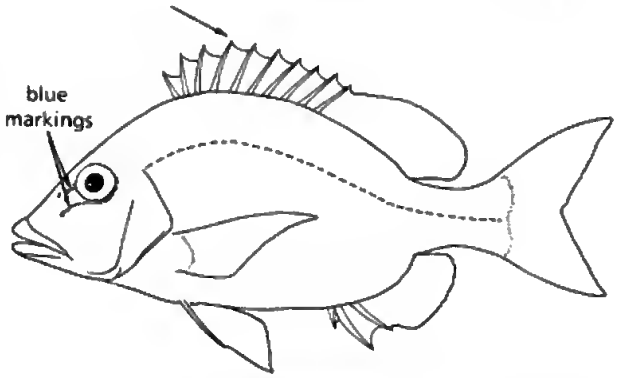
7b. Body depth 2.9 to 3.3 times in standard length; scale rows in transverse series below lateral line 15 to 17**



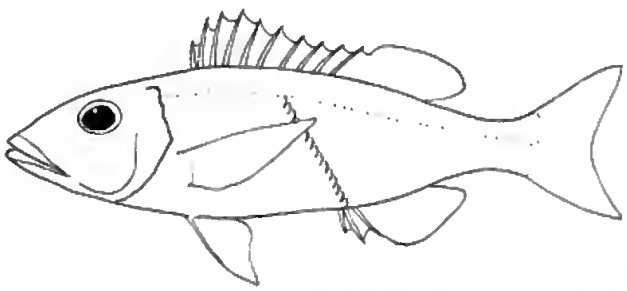
L. atlanticus Fig. 66



L. miniatus Fig. 67



L. haematopterus Fig. 68



L. variegatus Fig. 69

---

* For method of counting scale rows around caudal peduncle see Glossary of Technical Terms, Fig. 16

** For method of counting scale rows below lateral line see Glossary of Technical Terms, Fig. 17

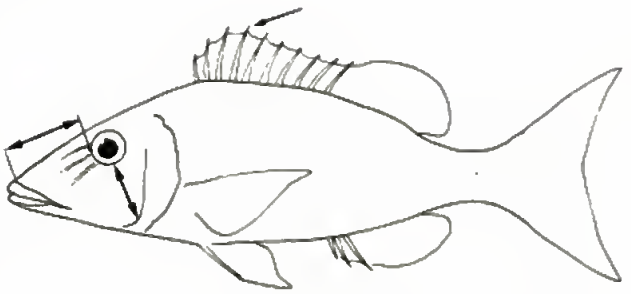
8a. Snout long, measured without the lip it is 1.3 to 1.4 times the cheek height; fourth dorsal spine usually the longest; three dark streaks radiating forward from eye on snout usually visible; inner surface of pectoral-fin base never red in life ..... ***L. microdon***
(Fig. 70, Plates V, 30 and VI, 31)

8b. Snout measured without the lip is 1.1 to 1.25 times the cheek height; third dorsal spine usually the longest; three distinct dark streaks radiating from the eye not readily apparent; inner surface of pectoral fin base sometimes red

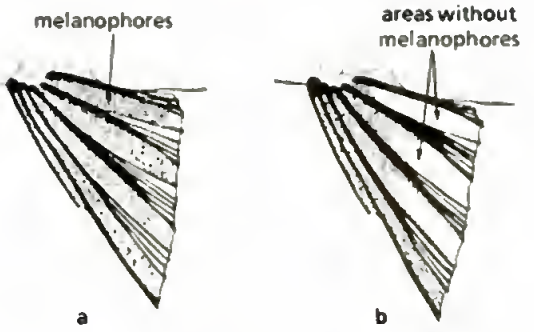
9a. Membrane between inner rays of pelvic fin mostly covered with melanophores (Fig. 71a)

10a. Interorbital area distinctly convex (Fig 72a); 9 to 11 scales in supratemporal patch; 16 or 17 scales in transverse series below lateral line ..... ***L. amboinensis***
(Fig. 73, Plate II, 11)

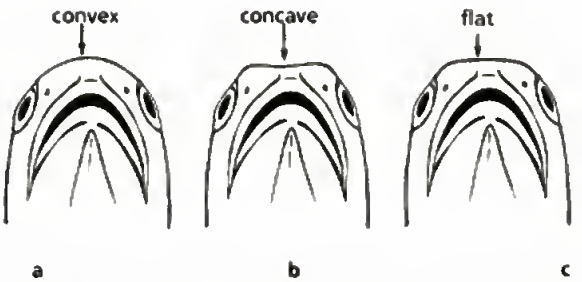
10b. Interorbital area distinctly concave (Fig 72b); 5 to 8 scales in supratemporal patch; 15 or 16 scales in transverse series below lateral line ..... ***L. xanthochilus***
(Fig. 74, Plate VIII, 46)



L. microdon Fig. 70

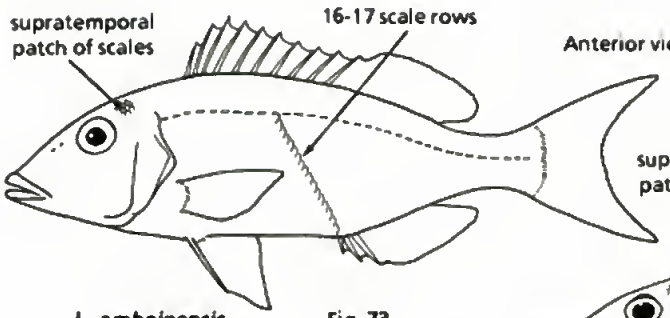


Pectoral fin Fig. 71

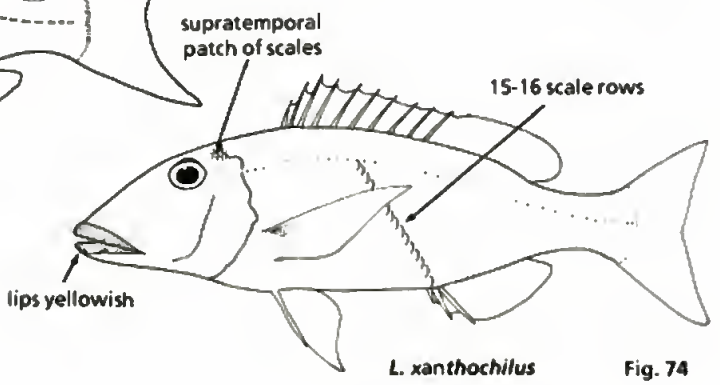


Anterior view of head showing shape of interorbital region

Fig. 72



L. amboinensis Fig. 73



L. xanthochilus Fig. 74

9b. Membrane between pelvic fin rays closest to body without a dense covering of melanophores (Fig 71b)

11a. Area on snout directly in front of eye with a prominent hump, snout profile distinctly concave (Fig. 75a)

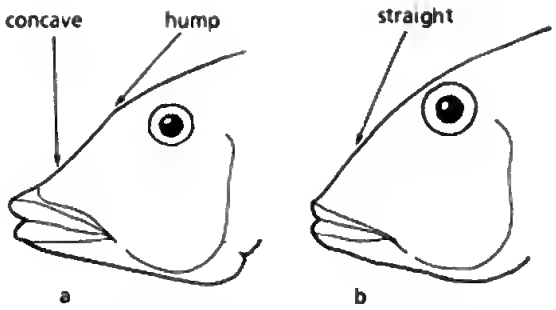
12a. Bright red subtriangular blotch above pectoral fin base; pectoral fin base, edge of opercle and lips also red in life ..... ***L. conchyliatus*** (Fig. 76, Plate III, 15)

12b. Posterior edge of preopercle, upper posterior edge of opercle, and base of pectoral fin red in life ... ***Lethrinus*** **sp.1** (Fig. 77, Plate VII, 43)

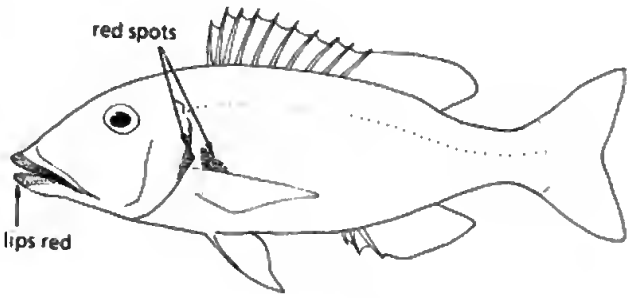
11b. Area on snout in front of eye without a prominent hump, profile of snout nearly straight or slightly concave (Fig. 75b)

13a. Wide scaleless area on upper posterior margin of opercle (Fig 78a).. ***L. rubrioperculatus*** (Fig. 79, Plate VII, 41)

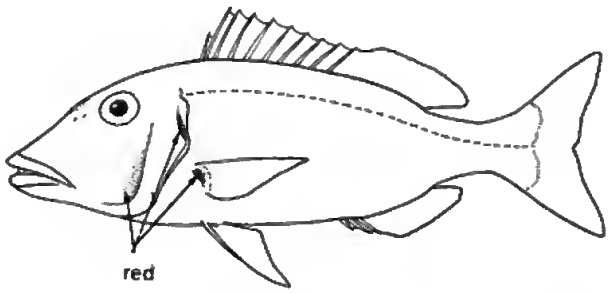
13b. Upper posterior margin of opercle without wide scaleless area (Fig 78b)



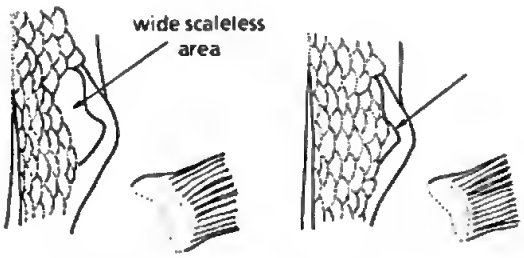
Snout profiles Fig. 75



L. conchyliatus Fig.76

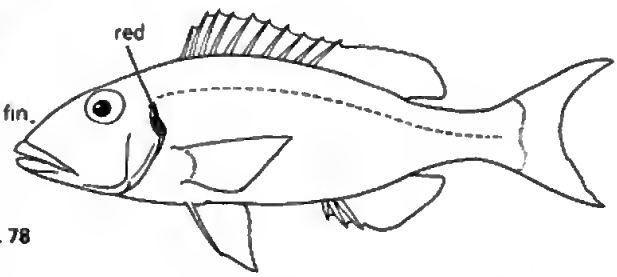


Lethrinus . sp 1 Fig. 77



a scaleless region b fully scaled region

Posterior margin of opercle Fig. 78



L. rubrioperculatus Fig. 79

14a. Interorbital area usually concave (Fig. 72b); base of pectoral fin, upper posterior edge of opercle and posterior edge of preopercle red in life .... ***L. reticulatus***
(Fig. 80, Plate VII, 40)

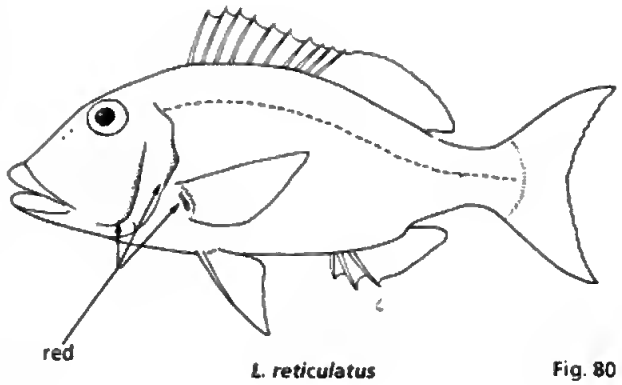
14b. Interorbital area flat (Fig. 72c) or convex (Fig. 72a); no red markings in life

15a. Angle of snout relative to upper jaw 57 to 60 degrees*; a large irregular black blotch on sides, bordering under the lateral line and below the soft-rayed portion of the dorsal fin ..... ***L. semicinctus***
(Fig. 81, Plate VII, 42)

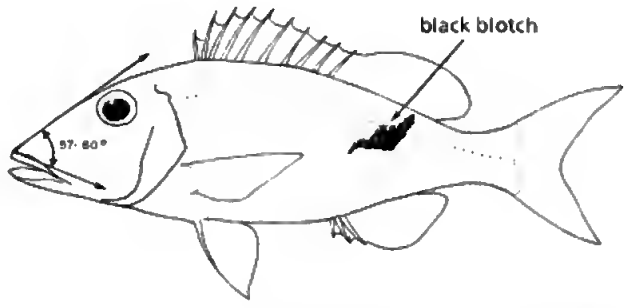
15b. Angle of snout relative to upper jaw 61 to 66; no large black blotch on side ..... ***L.*** sp 2
(Fig. 82, Plate VIII, 44)

3b. Longitudinal scale rows between lateral line and base of middle dorsal spines 5 1/2; lateral teeth in jaws conical, rounded, molars or molars with a tubercle (Fig. 65)

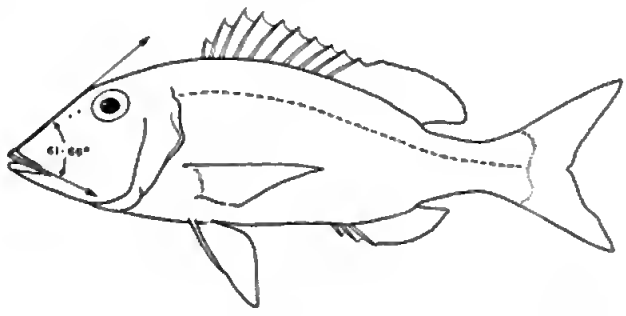
16a. Snout long, when measured without the lip it is 1.4 to 1.5 times the cheek height; body relatively slender, depth 3.0 to 3.2 times in standard length; no red markings on opercle or base of pectoral fin in life ..... ***L. olivaceus***
(Fig. 83, Plate VII, 38)



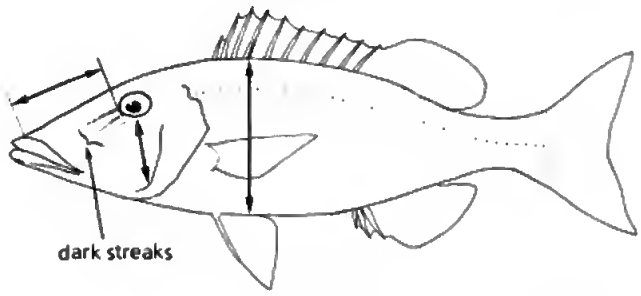
L. reticulatus Fig. 80



L. semicinctus Fig. 81



Lethrinus sp.2 Fig. 82



L. olivaceus Fig. 83

* For measurement of snout angle see Glossary of Technical Terms, Fig. 5

16b. Snout when measured without lip is 1.0 to 1.1 times the cheek height; body deep, its depth 2.6 to 2.8 times in standard length; posterior margin of opercle red and base of pectoral fin often red in life ..... *L. lentjan*
(Fig. 84, Plate V, 26,27)

2b. Most of the inner surface of pectoral fin base covered with scales (Fig. 64b)

17a. Small dark blotches around lower rim of orbit, usually persistent in preserved material (longitudinal scale rows between lateral line and base of fifth dorsal spine variable, changing from 5 1/2 to 4 1/2 under the second to seventh dorsal spines) ..... *L. enigmaticus*
(Fig. 85, Plate III, 17)

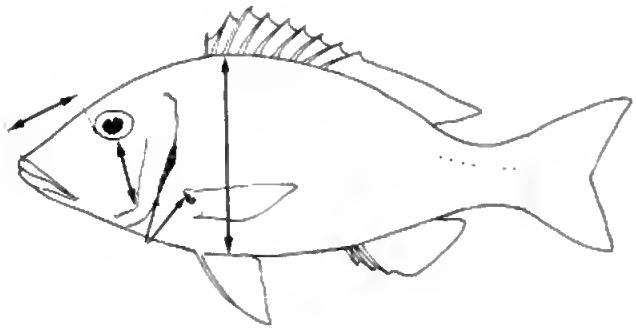
17b. No persistent small dark blotches around lower rim of orbit

18a. A large black blotch bordering below the lateral line and centered on the posterior tip of the pectoral fin, usually persistent in preserved specimens (longitudinal scale rows between lateral line and base of fifth dorsal spine variable, either 4 1/2 or 5 1/2 scales) ..... *L. harak*
(Fig. 86, Plate IV, 24)

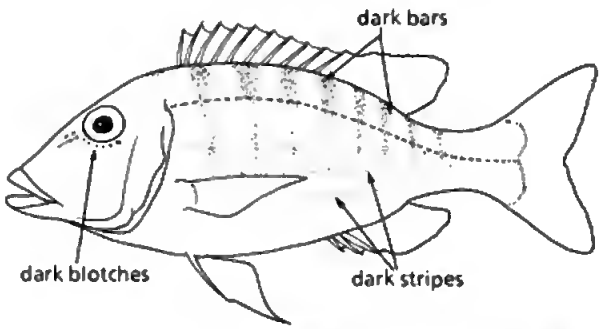
18b. No dark blotch below lateral line

19a. Longitudinal scale rows between lateral line and base of middle dorsal spines 4 1/2

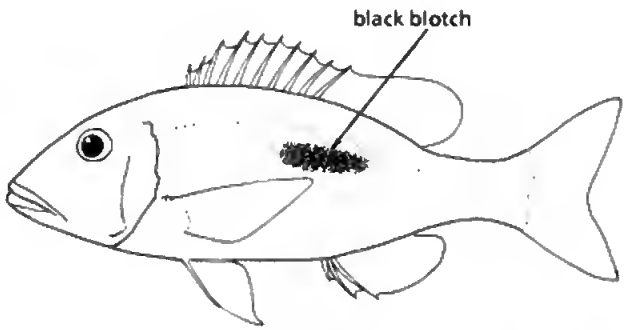
20a. The third, fourth or fifth anal rays usually the longest, much longer than the length of the base of the soft rayed portion of the anal fin, the length of the longest anal ray 0.9 to 1.1 times the length of the entire anal fin*



L. lentjan Fig. 84



L. enigmaticus Fig. 85



L. harak Fig. 86

* For measurement of anal fin base see Glossary of Technical Terms, Fig. 6

21a. Lateral line scales usually 47 or 48, sometimes 46; lateral teeth in jaws conical or rounded (Fig 65a,b); body depth 2 5 to 2 7 times in standard length; membranes between inner rays of pelvic fin usually densely covered with melanophores (Fig 71a) ..... ***L. erythracanthus***
(Fig. 87, Plate IV,18-20)

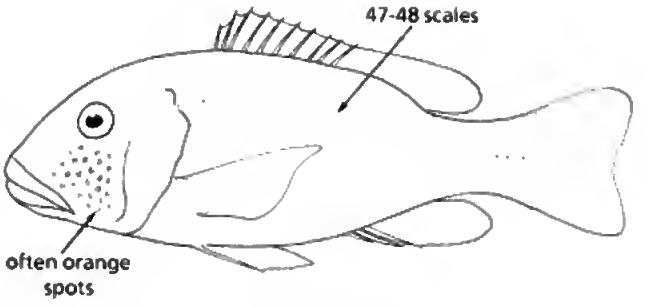
21b. Lateral-line scales 44 to 46; lateral teeth in jaws usually with distinct molars (Fig. 65c); body depth 2 3 to 2.6 times in standard length; membranes between inner rays of pelvic fin usually not densely covered with melanophores (Fig. 71b) ..... ***L. erythropterus***
(Fig 88, Plate IV,21)

20b. The first or second anal ray usually the longest, its length either less than, approximately equal to, or slightly longer than the length of the soft portion of the anal fin, its length 0 6 to 0 8 times in length of the base of the entire anal fin

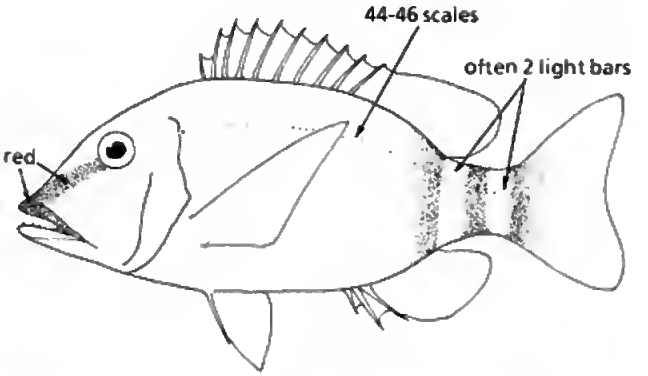
22a. Angle of the snout relative to upper jaw 52 to 62 degrees; lateral teeth in jaws conical (Fig 65a); the third dorsal spine usually the longest ..... ***L. miniatus***
(Fig. 89, Plate VI, 32-34)

22b. Angle of the snout relative to upper jaw 65 to 80 degrees; lateral teeth in jaws rounded or molars (Fig 65b,c); the fourth dorsal spine the longest

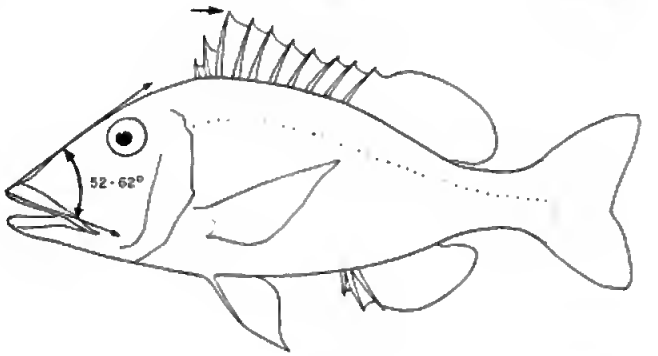
23a. Profile of head around eye nearly straight; usually 4 or 5 (rarely 3 or 6) scales in supratemporal patch ... ***L. mahsena***
(Fig 90, Plate V, 28,29)



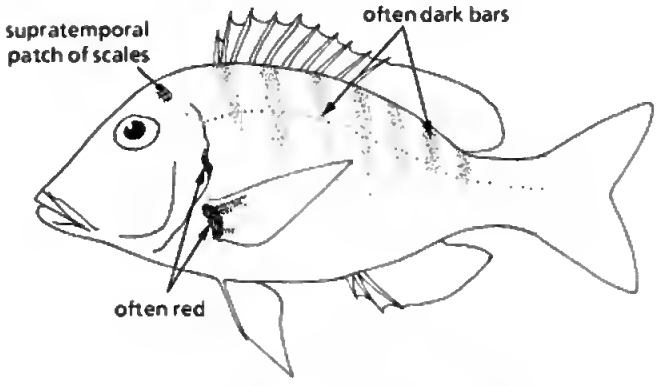
L. erythracanthus Fig. 87



L. erythropterus Fig. 88



L. miniatus Fig. 89



L. mahsena Fig. 90

23b. Profile of head around eye distinctly convex and angular; usually 6 or 7 (rarely 4, 5 or 8) scales in supratemporal patch *L. atkinsoni*
(Fig 91, Plate III, 12)

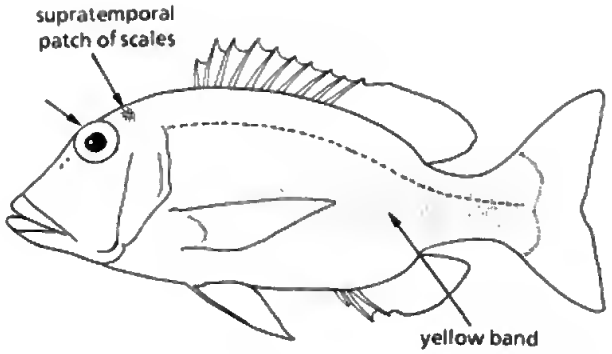
19b. Longitudinal scale rows between lateral line and base of middle dorsal spines 5 1/2

24a. Body depth 2.2 to 2.4 times in standard length, head length 0.8 to 0.9 times in body depth; profile of head around eye nearly straight or slightly concave

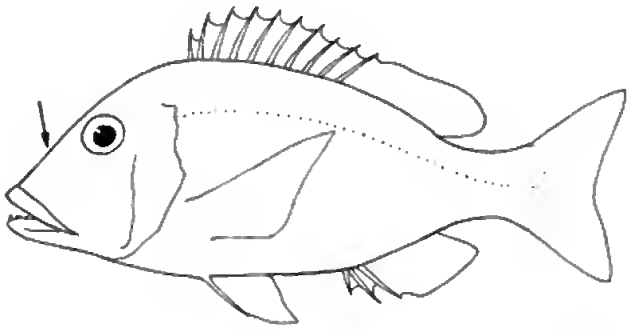
25a. Profile of snout straight or nearly straight; lateral teeth in jaws rounded, or molars (Fig 65b,c); no blue stripes in front of eye in life ..... *L. crocineus*
(Fig 92, Plate III, 16)

25b. Profile of snout concave; lateral teeth in jaws conical (Fig. 65a); 3 blue stripes radiating in front of the eye in life ..... *L. laticaudis*
(Fig 93, Plate V, 25)

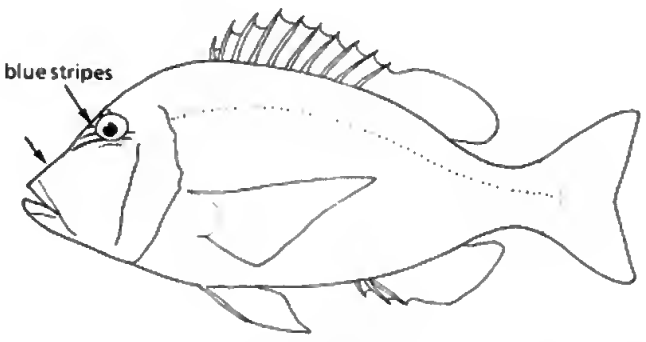
24b. Body depth either 2.5 to 2.9 times in standard length and profile of head around eye either concave, nearly straight, or slightly convex or, body depth 2.4 to 2.6 times in standard length and profile of head around eye distinctly convex; head length either 0.9 to 1.1 times in body depth and profile of head around eye either concave, nearly straight, or slightly convex or, head length 0.8 to 0.9 times in body depth and profile of head near eye convex



L. atkinsoni Fig. 91



L. crocineus Fig. 92



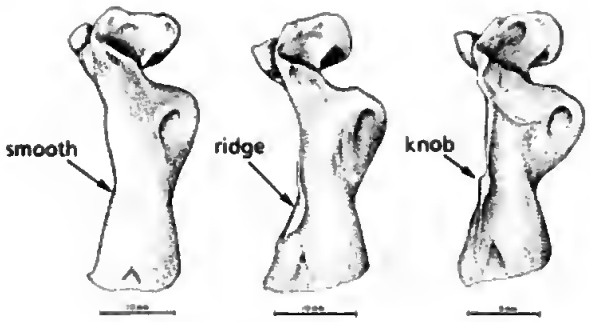
L. laticaudis Fig. 93

26a. Posterior edge of preopercle and opercle red in life; snout relatively short and blunt, preorbital width 0.7 to 0.8 times in cheek height*; angle of snout relative to upper jaw 64 to 73 degrees; outer surface of maxilla usually smooth, without a prominent ridge or knob (Fig. 94a); head length 0.8 to 0.9 times in body depth; profile of head around eye distinctly convex ..... ***L. ornatus***
(Fig. 95, Plate VII, 39)

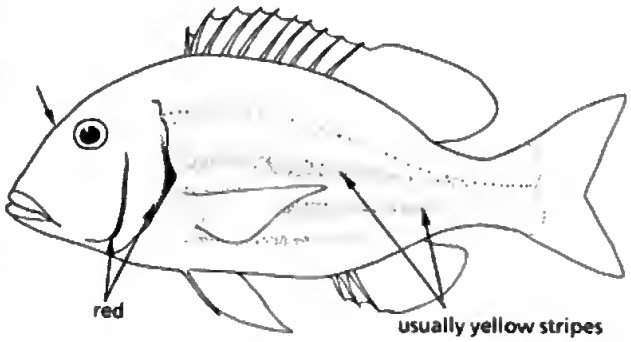
26b. Posterior edge of preopercle not red, but edge of opercle and base of pectoral fin sometimes red in ***L. lentjan***; snout blunt or sharp, the preorbital width 0.7 to 1.0 times in cheek height, if the preorbital width is less than 0.8 times in cheek height, there is a prominent ridge (Fig. 94b) or knob (Fig. 94c) on the surface of the maxilla; angle of snout relative to the upper jaw 52 to 69 degrees; if this angle is greater than 64 degrees, there usually is a ridge or knob on the surface of the maxilla; head length 0.9 to 1.1 times in body depth; profile of head around eye slightly concave, nearly straight, or convex

27a. Scale rows in lower series around caudal peduncle usually 13-14**; lateral teeth include distinct molars (Fig. 65c); eye relatively large, 3.4 to 4.0 times in head length, and close to the dorsal profile; profile of head near eye often slightly convex ..... ***L. borbonicus***
(Fig. 96, Plate III, 14)

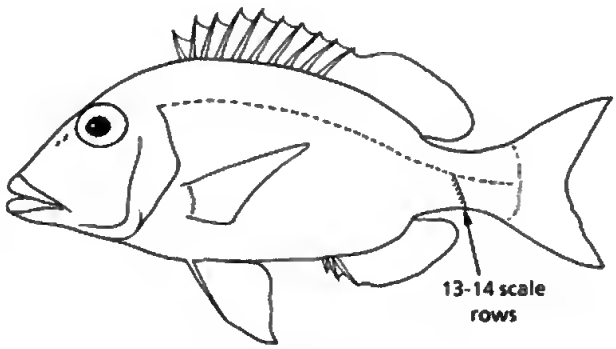
27b. Scale rows in lower series around caudal peduncle most frequently 15; lateral teeth in jaws either rounded (Fig. 65b), molars with tubercles (Fig. 65d), or simple molars (Fig. 65c); eye 3.8 to 5.1 times in head length, usually not very close to the dorsal profile; profile of head near eye nearly straight or slightly concave



Outer surface of left maxilla Fig. 94



L. ornatus Fig. 95



L. borbonicus Fig. 96

* For method of measuring cheek height and preorbital width, see Fig. 9

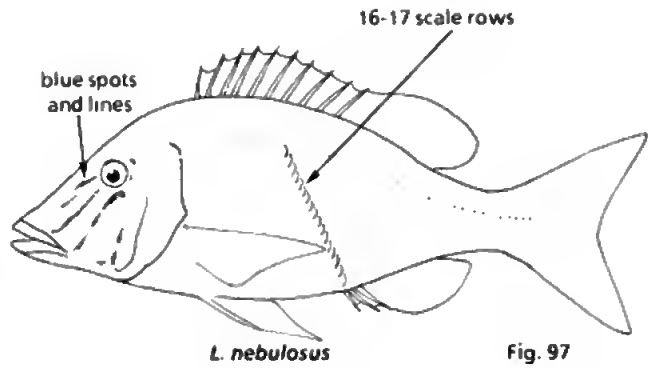
** For method of counting scale rows, see Fig. 6

28a. Melanophores covering most of pelvic fin membranes, including the area near inner rays (Fig 71a); 16 or 17 scale rows in transverse series from origin of anal fin to lateral line; three blue lines and/or rows of blue spots radiating forward from eye on snout in life ..... ***L. nebulosus***
(Fig 97, Plate VI, 35,36)

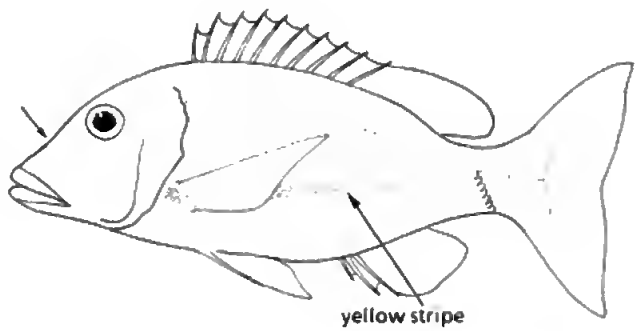
28b. Melanophores largely absent on membranes of inner rays of pelvic fins (Fig. 71b); 15 or 16 scale rows in transverse series from origin of anal fin to lateral line; no prominent blue lines radiating from eye in life

29a. Posterior edge of opercle and sometimes outer base of pectoral fin red in life; surface of maxilla smooth or with a ridge (Fig 94a,b); lateral teeth in jaws either rounded, molars with a tubercle or simple molars (Fig 65); profile of snout straight ..... ***L. lentjan***
(Fig 84, Plate V, 26,27)

29. Posterior edge of opercle and outer base of pectoral fin never red; maxilla with a knob (Fig. 94c); lateral teeth in jaws rounded (Fig 65b); profile of snout concave ..... ***L. obsoletus***
(Fig 98, Plate VI, 37)



L. nebulosus **Fig. 97**



L. obsoletus **Fig. 98**

Table 5

Variation in presence or absence of pectoral axil scales, number of scale rows in transverse series above lateral line to base of mid-dorsal spines, and number of lateral-line scales for species of *Lethrinus*

	Pectoral axil scales		Scale rows above lateral line		Number of lateral-line scales						
	+	-	4½	5½	42	44	45	46	47	48	49
L. amboinensis		4	4						3	1	
L. atkinsoni	18		18					6	12		
L. atlanticus		16	16		1	1	13	1			
L. borbonicus	12			12				5	6	1	
L. conchyliatus		2	1							1	
L. crocineus	5			5				3	2		
L. enigmaticus		9	6	3					3	6	
L. erythracanthus	12		12					2	8	2	
L. erythropterus	21		21			5	11	5			
L. genivittatus	44	8	18					7	11		
L. haematopterus		12	12						3	7	2
L. harak	16		1	15			1	5	10		
L. laticaudis	2			2					2		
L. lentjan	148	66		18		1		10	7		
L. mahsena	15		15				1	3	8	3	
L. microdon		10	10						7	3	
L. miniatus	8	1	8						2	6	
L. nebulosus	22			22				5	13	4	
L. obsoletus	18			18			1	3	12	2	
L. olivaceus		12		12				1	5	6	
L. ornatus	18			18		1		7	10		
L. reticulatus		12	12					1	8	3	
L. rubrioperculatus		13	13						7	5	1
L. semicinctus		14	14					1	5	8	
Lethrinus sp. 1		5	5						2	3	
Lethrinus sp 2		5	5							4	1
L. variegatus		13	13				1	10	2		
L. xanthochilus		13	12						6	6	

Lethrinus amboinensis Bleeker, 1854 Fig 99, Plate II, 11 **LETH Leth 21**

Lethrinus amboinensis Bleeker 1854d, Nat Tijdsch Ned Indie, 6:490 (Ambon).

Synonyms: None

FAO Names: En - Ambon emperor.

Fig 99

Diagnostic Features: Body moderately elongate, its depth 3 1 to 3 4 times in standard length. Head length 1.1 to 1.3 times in body depth, 2 6 to 2.8 times in standard length, dorsal profile in front of eye with a distinct hump in large individuals; snout moderately long, its length about 1.7 to 1 9 times in head length, measured without the lip the snout is 0.7 to 0.9 times in cheek height, its dorsal profile concave, snout angle relative to upper jaw between 45 and 55 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, about halfway between orbit and anterior nostril; eye not situated close to dorsal profile, its length 4 9 to 6.2 times in head length; cheek not very high, its length 2 6 to 2 9 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth, or with a longitudinal ridge Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine usually the longest, its length 2.4 to 2.7 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length much less than the base of the soft portion of the anal fin and 0.5 to 0.6 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with dense melanophores. Lateral-line scales 47 to 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; 15 or 16 (usually 15) rows in lower series of scales around caudal peduncle; 9 to 11 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour**: Body yellowish with scattered indistinct dark blotches; head brown, sometimes with light streaks; lips reddish; the pectoral axil orangish; the basal portion of the center rays of pectoral fin white, the outer edges yellow; pelvic and anal fins white or yellowish; dorsal and caudal fins mottled brown or yellow with an orange or reddish edge

Geographical Distribution: Indonesia, northwest Australia, Philippines to southern Japan, eastward through the Marshall Islands, Solomons, Samoa and the Marquesas (Fig. 100).

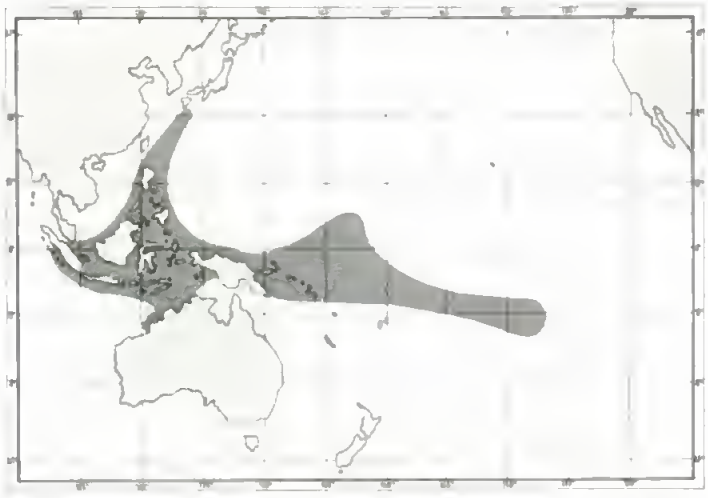


Fig. 100

Habitat and Biology: Inhabits deeper waters of coral reefs and adjacent sandy bottoms. Feeds primarily on fishes and crustaceans. Very little is known of the biology of this fish, perhaps because it is easily mistaken (particularly larger individuals) for either ***L. microdon*** or ***L. olivaceus***.

Size: Maximum reported size to about 70 cm total length, commonly 30 to 50 cm total length.

Interest to Fisheries: Caught primarily with handlines. Marketed fresh.

Local Names: JAPAN: Yokoshima-fuefuki; PHILIPPINES: Batilya, Kilawan, Katambak.

Literature: Masuda et al. (1984); Sainsbury et al. (1985, as ***L. microdon***).

Remarks : This species is easily confused with ***L. microdon*** although it can be distinguished on the basis of snout length and, when specimens are fresh, the axil of the pectoral fin is red in ***L. amboinensis***, while ***L. microdon*** lacks this red mark.

The type specimens of this species are small (3 syntypes, 56.0 to 83.7 mm SL) but their characteristics agree well with a number of specimens of this species that I recently collected in the Philippines.

Lethrinus atkinsoni Seale, 1909

Fig. 101, Plate III, 12

LETH Leth 22

Lethrinus atkinsoni Seale, 1909, Phil. Jour. Sci., 4(6): 515, pl. 11 (Philippines).

Synonyms: None

FAO Names: En - Pacific yellowtail emperor

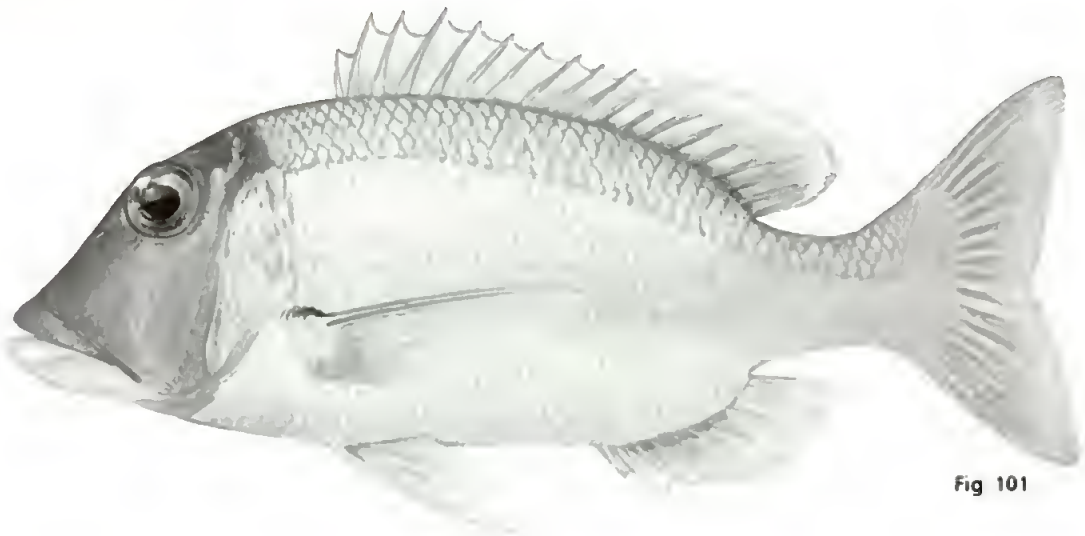


Fig. 101

Copyright FAO Rome

Diagnostic Features: Body moderately deep, its depth 2.3 to 2.6 times in standard length. Head length 0.8 to 0.9 times in body depth, 2.7 to 3.0 times in standard length, dorsal profile near eye distinctly convex; snout moderately short and blunt, its length about 1.7 to 2.6 times in head length, measured without the lip the snout is 0.9 to 1.1 times in cheek height, its profile steep and nearly straight, snout angle relative to upper jaw between 65 and 70 degrees; interorbital space convex or slightly convex; posterior nostril an oblong longitudinal opening, closer or slightly closer to orbit than to anterior nostril; eye situated close to dorsal profile (except in very large individuals), its length 3.2 to 5.0 times in head length; cheek high, its length 2.0 to 2.9 times in head length; lateral teeth in jaws rounded or molars; outer surface of maxilla smooth, or with a slight longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine usually the longest, its length 2.6 to 4.0 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length longer than the base of the soft portion of the anal fin and 0.7 to 0.9 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 46 to 47; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; 13 to 15 (usually 14) rows in lower series of scales around caudal peduncle; 4 to 8 (usually 6 or 7) scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour**: upper sides bluish-grey, tan or yellowish, white ventrally, the caudal peduncle and sometimes a broad indistinct band on sides yellow; head brown, lips reddish; fins pale, yellowish, orange or reddish; the base of pectoral fin, basal membranes of anal fin and edges of pelvic, dorsal, anal and caudal fins often reddish.

Geographical Distribution: Indonesia, northern Australia, Philippines to southern Japan, widespread throughout West Pacific to the Tuamotus (Fig. 102).

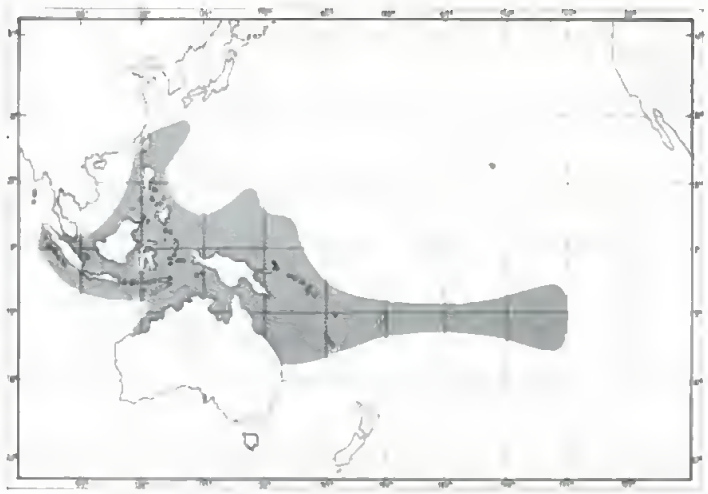


Fig. 102

Habitat and Biology: Inhabits outer reef slopes, sandy areas in lagoons and seagrass beds to depths of around 30 m. Reported as both typically solitary and swimming in schools. Feeds primarily on crustaceans, molluscs and fish.

Observations of maximum age (t_{max}), and estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K), and rate of natural mortality (M) have been made for *L. atkinsoni* in New Caledonia: t_{max} = 23 years for males and 24 years for females, $L_{infinity}$ = 32.7 cm standard length, K = 0.28, M = 0.73.

Size: Maximum size reported as around 40 to 50 cm total length, commonly 30 to 35 cm total length.

Interest to Fisheries: Caught primarily by handline, trawl, shore seine and gillnet. Marketed mostly fresh. Good eating but not as sought after as other emperors in some areas due to its small size. Puts up a good fight on a handline. Reported to contribute around 4% to the total commercial catch in New Caledonia.

Local Names: AUSTRALIA: Yellow-tailed emperor, Tricky snapper, Yellow morwong, Reticulated emperor; JAPAN: Iso-fuefuki; NEW CALEDONIA: Bossu doré; PHILIPPINES: Batilya, Katambak, Kilawan, Madas, Sapingan; POLYNESIA: Tamure, Tuamotu emperor.

Literature: Bagnis et al. (1972, as *L. mahsena*); Coleman (1981, as *L. reticulatus*); Fourmanoir & Laboute (1976, as *L. mahsena*); Gloerfelt-Tarp & Kailola (1984, as *L. mahsena*); Grant (1982, as *L. mahsena*); Lee (1986, as *L. mahsena*); Masuda et al. (1984, as *L. mahsena*); Sainsbury et al. (1985, as *L. mahsena*); Schroeder (1980, as *Lethrinus* sp.)

Remarks: This species has most frequently been named *L. mahsena*. There are many consistent differences however, in colour, body shape and meristic counts. Although these forms appear to be allopatric, there is little doubt that they represent different species. It is surprising that an earlier name for this species has not been found, because it is widespread and common in the Western and Central Pacific Ocean.

Lethrinus atlanticus Valeciennes, 1830 Fig. 103, Plate III, 13 **LETH Leth 8**

Lethrinus atlanticus Valenciennes in C. & V. 1830, Hist. nat. poiss., 6: 275 (Cape Verde Islands).

Synonyms: None.

FAO Names: En - Atlantic emperor

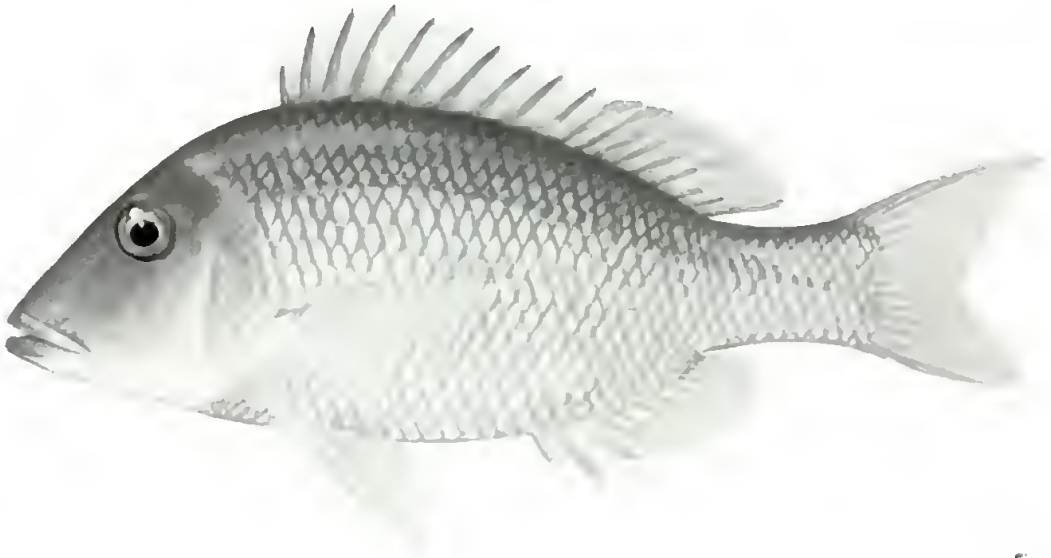


Fig. 103

Diagnostic Features: Body moderately deep, its depth 2.5 to 2.8 times in standard length. Head length 0.9 to 1.0 times in body depth, 2.7 to 3.0 times in standard length, dorsal profile near eye nearly straight or slightly convex; snout moderately long and pointed, its length 1.9 to 2.4 times in head length, measured without the lip the snout is 0.8 to 1.0 times in cheek height, its profile fairly steep and straight, snout angle relative to upper jaw between 55 and 60 degrees; interorbital space nearly flat or slightly convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.4 to 4.3 times in head length; cheek moderately high, its length 2.6 to 3.3 times in head length; lateral teeth in jaws all conical; outer surface of maxilla smooth, without a knob or pronounced longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 2.4 to 3.0 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray the longest, its length greater than the base of the soft portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes usually with fairly dense melanophores, except the membranes between the rays closest to the body. Lateral-line scales 42 to 46; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 13 or 14 scale rows in transverse series between origin of anal fin and lateral line; 13 or 14 rows in lower series of scales around caudal peduncle; 4 to 7 scales in supratemporal patch; inner surface of pectoral fin axil scaleless; posterior angle of operculum fully scaled. **Colour:** olive green or brown and pinkish, cheeks with a network of fine reticulations below the eye

Geographical Distribution: West coast of Africa from Senegal to Gabon, Cape Verde Islands, Principe Islands, Sao Tomé Islands and Rôlas Islands (Fig. 104).

Habitat and Biology: Inhabits shallow coastal waters to about 50 m. It feeds primarily on bottom-living invertebrates.

Size: Maximum total length to about 50 cm; common to around 30 cm.

Interest to Fisheries: Caught with bottom trawls, set nets, purse seines and on hook-and-lines. Usually marketed fresh, smoked, and dried salted.

Local Names: JAPAN: Taiseiyo-fuefuki; GERMANY: Atlantikkehrer; PORTUGUESE: Bica.

Literature: Fischer, Bianchi and Scott (eds) (1981).

Remarks: The combination of teeth types, body shape and scale counts for this species are very different from other species of *Lethrinus*. Moreover, this unique combination of characters was found to be consistent among all specimens of *Lethrinus* examined from many locations in the tropical West Atlantic Ocean; there is little doubt that only a single species of *Lethrinus* exists in this ocean.

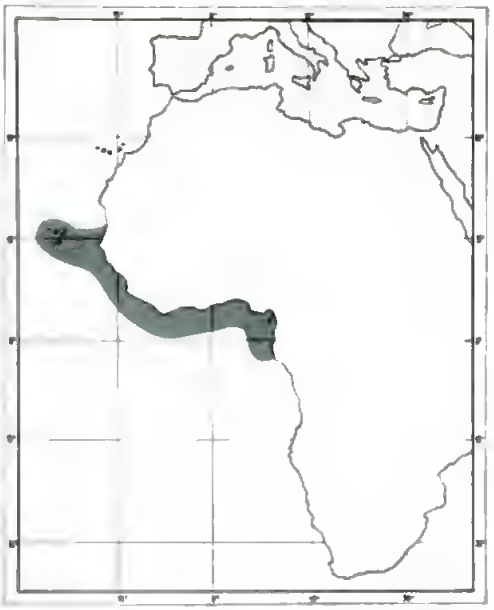


Fig. 104

Lethrinus borbonicus Valenciennes, 1830 — Fig. 105, Plate III, 14 — **LETH Leth 13**

Lethrinus borbonicus Valenciennes in C. & V., 1830, Hist.nat.poiss., 6:303 (Réunion).

Synonyms: ***Lethrinus bungus*** Valenciennes (1830).

FAO Names: En - Snubnose emperor.

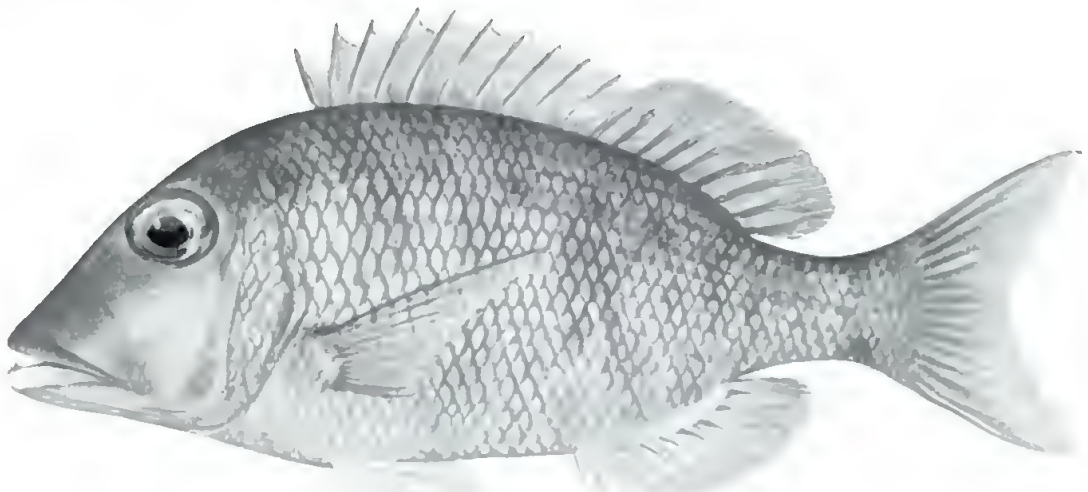


Fig. 105

Diagnostic Features: Body moderately deep, its depth 2 5 to 2 8 times in standard length Head length 0 9 to 1.0 times in body depth, 2 7 to 2 9 times in standard length, dorsal profile near eye nearly straight or slightly convex; snout moderatly short and blunt, its length about 2.0 to 2 2 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 55 and 70 degrees; interorbital space usually convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye usually situated close to dorsal profile, its length 3 5 to 4.0 times in head length; cheek moderately high, its length 2.4 to 2 9 times in head length; lateral teeth in jaws with strong molars; outer surface of maxilla with a distinct longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2 5 to 3 1 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to the length of the base of the soft-rayed portion of the anal fin and 0 6 to 0 8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; 13 or 14 (rarely 15) rows in lower series of scales around caudal peduncle; 6 to 8 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour** : body dark grey or yellow-brown, the centers of scales lighter, sometimes an irregular pattern of broken dusky bars, whitish on lower body; head brown-grey; pectoral and pelvic fins white or pinkish; dorsal and anal fins mottled white or yellowish with reddish edge; caudal with indistinct reddish bands

Geographical Distribution: Western Indian Ocean, including the Red Sea and Arabian (Persian) Gulf to Reunion (Fig 106). Reports of this species elsewhere are probably due to misidentification

Habitat and Biology: Found in sandy areas near reefs during daytime, to depths of around 40 m, sometimes in small groups. During night-time they are solitary and range over reef-flats and slopes in depths as shallow as 1 m where they feed primarily on echinoderms, molluscs and crustaceans.

Estimates of asymptotic length ($L_{infinity}$) and coefficient of growth (K), have been made for ***L. borbonicus*** in the Gulf of Aden: $L_{infinity}$ = 42 6 cm total length, and K = 0 48

Size: Maximum size around 40 cm total length, commonly to 20 to 30 cm total length.

Interest to Fisheries: Captured mostly in traps, trawls and handlines. A minor component of fisheries catch in most countries where it is landed.

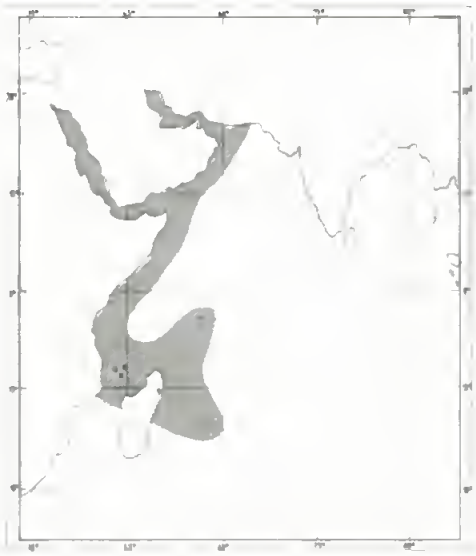


Fig. 106

Local Names: JAPAN: Nise-hana-fuefuki; KUWAIT: Sheiry; SOUTH AFRICA: Snubnose emperor, Stompneus-keiser; TANZANIA: Changu, Changu chole, Changu kidogo

Literature: Kuronuma & Abe (1972, 1986, as ***L. fletus*** and ***L. kallopterus***); Randall, (1983, as ***L. mahsenoides***); Sato in Fischer & Bianchi (eds) (1984, as ***L. mahsenoides***); Smith, J.L.B. (1959); Smith, M.M. (1986); Wheeler (1961, as ***L. choerorhynchus***).

Remarks : The taxonomy of this species has been considerably confused Smith (1959) listed ***L. mahsenoides*** as a junior synonym of ***L. borbonicus***. Valenciennes (1830) named ***L. mahsenoides*** from a description and specimen collected by Ehrenberg, and ***L. borbonicus*** from a Gaimard description and type The name ***L. borbonicus*** is clearly available according to the present Code of Zoological Nomenclature Sato (1978) however, later used the name ***L. mahsenoides*** as the senior synonym and ***L. borbonicus*** as the junior synonym As first revisor, Smith's use of the name ***L. borbonicus*** takes precedence There is additional justification to reject the use of ***L. mahsenoides*** because there appears to have been confusion in the designation of types for this nominal species. There is no doubt that the types currently listed as ***L. mahsenoides*** and ***L. borbonicus*** are in fact, the same species. The type description of ***L. mahsenoides*** however, clearly describes the colours of the Red Sea species that we recognize here as ***L. lentjan***. This description includes mention of the red margin of the opercle, greenish body colour and the white spots in the angle of scales that are characteristic of ***L. lentjan*** and uncharacteristic of ***L. borbonicus***. This description is perhaps the reason why some recent accounts of ***L. mahsenoides*** (in reference to the form recognized here as ***L. borbonicus***) mention that the species sometimes has a red margin of the opercle when in fact, it never does. It is possible that Ehrenberg's specimens and description somehow became confused To complicate matters further, after examination

of the type and translation of the description, it became evident that another Valenciennes' name, *L. bungus* is synonomous with *L. borbonicus*. *L. bungus* has most frequently been synomomized with *L. mahsena*, but it is clearly not this species. In addition, it is likely that a third Valenciennes' name, *L. ehrenbergii*, is also attributable to this species. *L. bungus* has page preference over *L. borbonicus*; however, in order to maintain some semblance of stability, I choose to follow Smith in recognizing *L. borbonicus* as the name to represent this form.

Lethrinus conchyliatus (Smith, 1959) Fig. 107, Plate III, 15 **LETH Leth 9**

Lethrinella conchyliatus Smith, 1959, Rhodes Univ. Ichth. Bull., 17.292, pl. 22 fig. E (Pinda).

Synonyms: ***Lethrinus floridus*** Wheeler, 1961

FAO Names: En - Redaxil emperor.

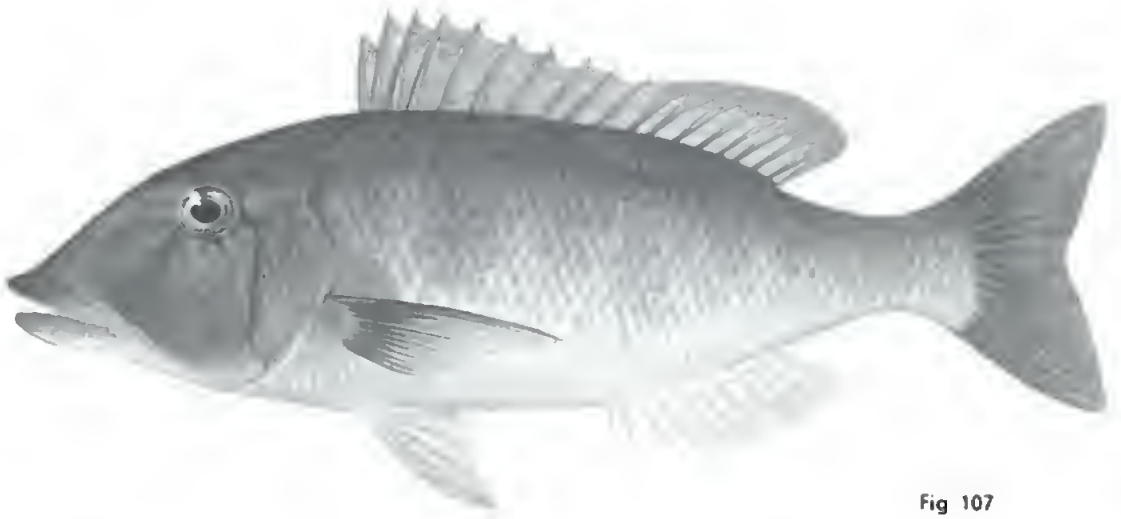


Fig. 107

Diagnostic Features: Body fairly elongate, its depth 3.2 to 3.4 times in standard length. Head length about 1.1 times in body depth, around to 2.8 times in standard length, dorsal profile near eye convex; snout length about 1.7 to 1.8 times in head length, measured without the lip the snout is around 0.8 to 0.9 times in cheek height, its dorsal profile concave with a hump in front of eye, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye removed from dorsal profile, its length around 4.6 times in head length; cheek length around 2.6 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length shorter than the length of the base of the soft-rayed portion of the anal fin and around 0.6 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral line scales 47 or 48, cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; about 8 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour:** body and head brownish or grey, lighter ventrally; lips, base and patch above base of pectoral fin, and edge of operculum red; fins orangish, dusky or mottled.

Geographical Distribution: Indian Ocean, from Tanzania, northern Madagascar, Chagos, Andamans and southwestern Indonesia (Fig. 108).

Fig. 108

Habitat and Biology: Inhabits reefs to depths of 220 m. Feeds primarily on fish and crustaceans. Gonads in spawning state have been recorded for this fish during the month of October.

Size: Maximum size to 76 cm, common to 50 cm.

Interest to Fisheries: Caught mostly by handlines, traps and trawls.

Local Names: JAPAN: Kataaka-fuefuki; MAURITIUS: Gueule de vin; SOUTH AFRICA: Redaxil emperor, Rooiskof-keiser; SEYCHELLES: Kaya la gueule rouge; Gueule de vin.

Literature: Gloerfelt-Tarp & Kailola (1984); Sato in Fischer & Bianchi (eds) (1984); Smith, J.L.B. (1959); Smith, M M. (1986).

Remarks : This species is not well represented in museums due to the relatively large capture size for most specimens.

Lethrinus crocineus Smith, 1959 — Fig. 109, Plate III, 16 — **LETH Leth 10**

Lethrinus crocineus Smith, 1959, Rhodes Univ .Ichth Bull., 17:290, pl.21 figs. F,G (Pinda).

Synonyms: None.

FAO Names: En - Yellowtail emperor

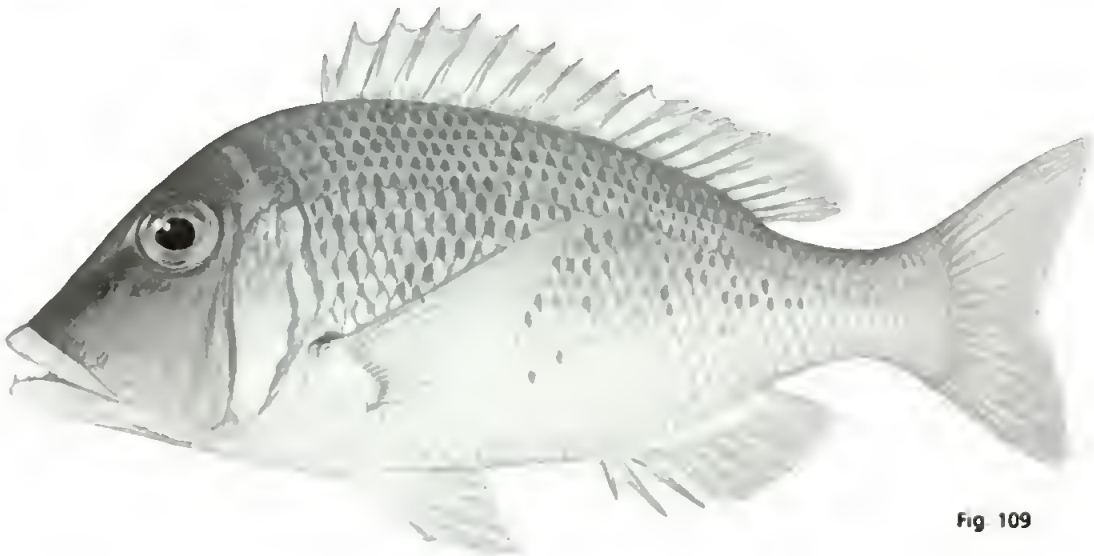


Fig. 109

Diagnostic Features: Body fairly deep, its depth 2.3 to 2.4 times in standard length. Head length 0.8 to 0.9 times in body depth, 2.6 to 2.8 times in standard length, dorsal profile near eye nearly straight; snout moderately short, its length about 1.9 to 2.1 times in head length, measured without the lip the snout is 1.0 to 1.1 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 65 and 75 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril or about halfway between orbit and anterior nostril; eye situated close or relatively removed from dorsal profile, its length 3.8 to 4.6 times in head length; cheek high, its length 2.0 to 2.4 times in head length; lateral teeth in jaws rounded or molars; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 3.2 to 3.6 times in body depth; anal fin with 3 spines and 8 soft rays, the first or second soft ray usually the longest, its length almost equal to or slightly less than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with or without dense melanophores. Lateral line scales 46 to 47; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 to 17 scale rows in transverse series between origin of anal fin and lateral line; 15 or 16 (usually 15) rows in lower series of scales around caudal peduncle; 6 to 8 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled or sometimes with a wide scaleless area. **Colour:** body tan or yellowish, the base of scales sometimes black; head brown; fins pale or yellowish, the edge of the dorsal fin reddish or yellowish.

Geographical Distribution: Western Indian Ocean, from Natal to the Seychelles and Sri Lanka (Fig. 110), possibly more widespread.

Habitat and Biology: Inhabits coastal areas and reefs to depths of around 150 m.

Size: Maximum size around 45 cm total length.

Interest to Fisheries: Caught mainly with handlines. Marketed mostly fresh.

Local Names: MOZAMBIQUE: Changu; SEYCHELLES: Lascar.

Literature: Sato in Fischer & Bianchi (eds) (1984); Smith (1959).

Remarks: This species is similar in body shape to ***L. mahsena*** and has previously been synonymized with it. Scale counts are consistently different in many respects with ***L. mahsena*** and there is little doubt that these are two distinct species.

Fig 110

Lethrinus enigmaticus Smith, 1959 — Fig. 111, Plate III, 17 — **LETH Leth 23**

Lethrinus enigmaticus Smith, 1959, Rhodes Univ.,Ichth.Bull., 17:291, pl.21 fig. E (Seychelles).

Synonyms: None

FAO Names: En - Blackeye emperor

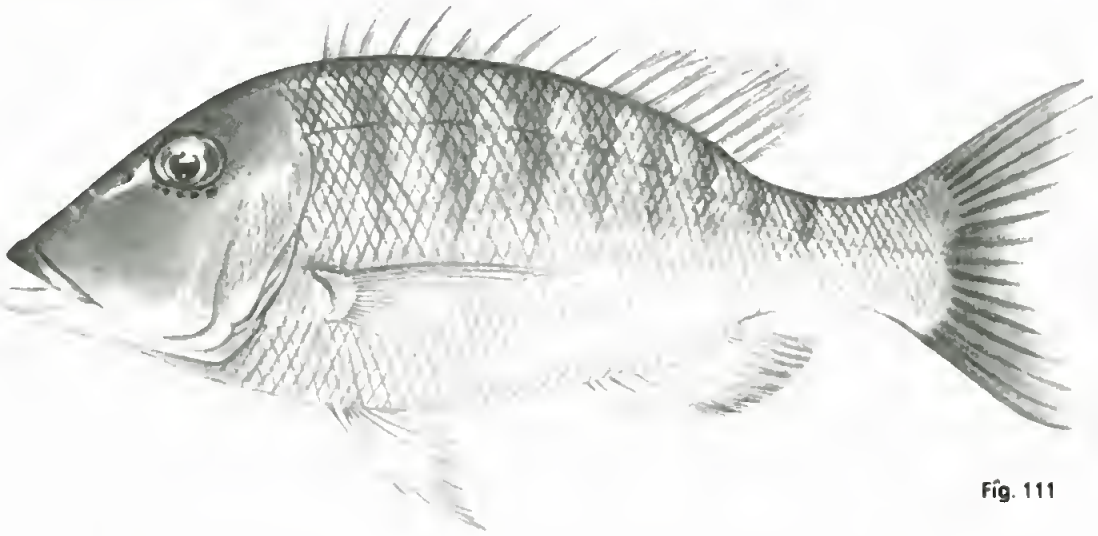


Fig. 111

Diagnostic Features: Body moderately deep, its depth 2.4 to 2.7 times in standard length. Head length 0.9 to 1.0 times in body depth, 2.6 to 2.9 times in standard length, dorsal profile near eye nearly straight; snout moderately short, its length about 1.8 to 2.0 times in head length, measured without the lip the snout is 0.8 to 1.0 times in cheek height, its dorsal profile slightly concave, snout angle relative to upper jaw between 65 and 75 degrees; interorbital space convex; posterior nostril an elongate oblong longitudinal opening, closer to orbit than to anterior nostril or about halfway between orbit and anterior nostril; eye situated fairly removed from dorsal profile, its length 3.9 to 4.9 times in head length; cheek moderately high, its length 2.1 to 2.6 times in head length; lateral teeth in jaws rounded; outer surface of maxilla with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest, the longest spine 3.0 to 3.7 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or slightly longer than the length of the base of the soft-rayed portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 47 or 48; cheek without scales; 4 1/2 or 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; 15 or 16 (usually 15) rows in lower series of scales around caudal peduncle; 4 to 6 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. Colour: body yellowish bronze or grey, lighter ventrally, sometimes with three bronze stripes on lower sides and seven to nine dark bars on upper sides; head grey, brown or bronze sometimes with a series of yellowish cross stripes on upper head and snout, a light streak radiating from eye to anterior nostril; the lower edge of the orbit with dark purplish spots; maxilla raddish; fins pale, yellowish or bronze.

Geographical Distribution: Known so far only from the Seychelles region (Fig. 112).

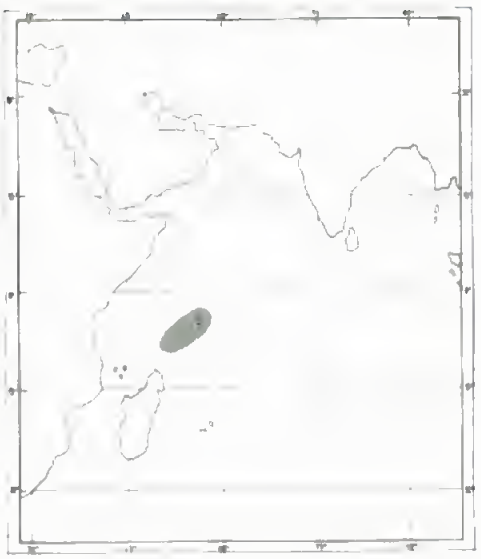


Fig. 112

Habitat and Biology: Inhabits seagrass beds, coral reefs and adjacent sandy areas to depths of 50 m. Feeds primarily on echinoderms, crustaceans and fish, and to a lesser extent on molluscs. A peak in spawning was noted in October in Saya de Malha, but this study did not sample all periods throughout the year. Smaller, more abundant females than males have been confirmed for the Saya de Malha population.

Estimates of asymptotic length ($L_{infinity}$) and coefficiant of growth (K) have been made for *L. enigmaticus* at Saya de Malha: $L_{infinity}$ = 53.9 cm standard length for males and 45.4 cm total length for females, and K = 0.15 for males and 0.18 for females.

Size: Maximum size to around 55 cm total length, commonly 25 to 40 cm total length.

Interest to Fisheries: Caught mostly by handlines and traps. Marketed mostly fresh. Contributes substantially to fisheries in Mauritus and Saya de Malha

Local Names: SEYCHELLES: Lascar

Literature: Allen & Steene (1987); Smith (1959).

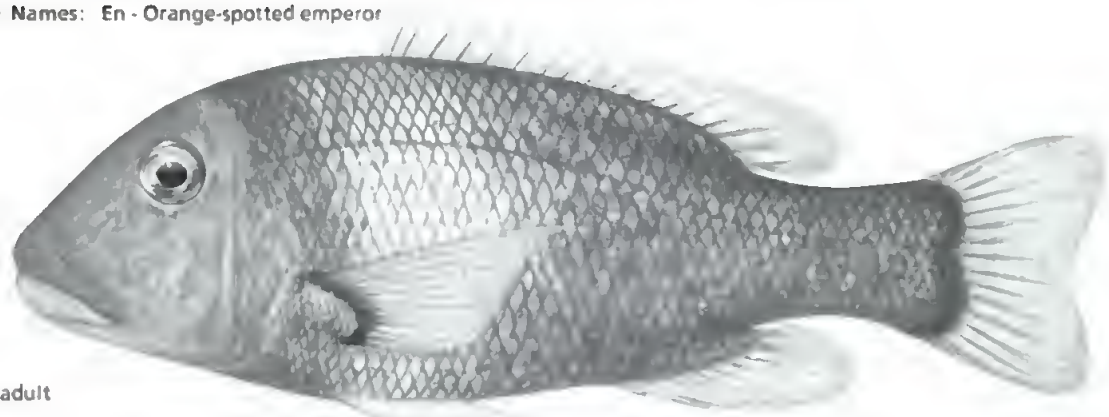
Remarks: Sato synonymized this species with ***L. mahsena***. I examined one of Smith's (1959) specimens which was included in his type description of this species together with an excellent series of specimens and photographs from the Indian Ocean, taken by L. Knapp of the Smithsonian Oceanographic Sorting Center. It is clear that this species, with its unique colour and combination of characters is distinct

Lethrinus erythracanthus Valenciennes, 1830 | Fig. 113, Plate IV, 18-20 | **LETH Leth 3**

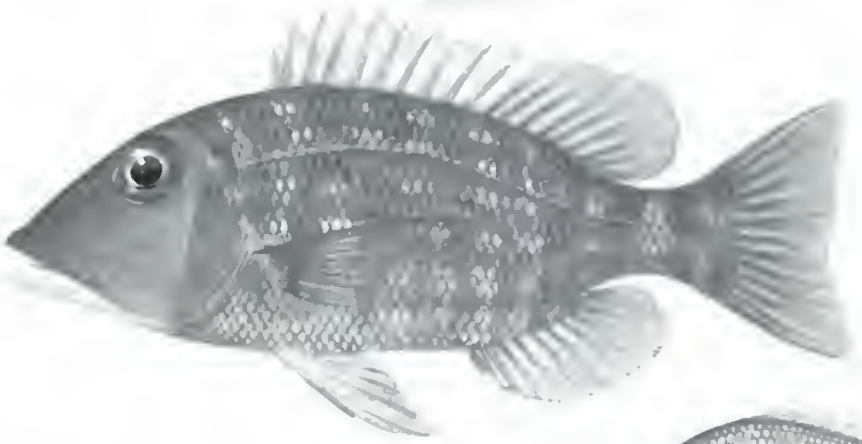
Lethrinus erythracanthus Valenciennes in C. & V., 1830 Hist.nat poiss., 6. 314 (Luganor).

Synonyms: ***Lethrinus cinnabarinus*** Richardson (1843); ***Lethrinus kallopterus*** Bleeker (1856).

FAO Names: En - Orange-spotted emperor



a. adult



b. subadu

c. juvenile

Fig. 113

Copyrighted material

Diagnostic Features: Body moderetely deep, its depth 2.5 to 2.7 times in standard length. Head length 0.9 to 1.0 times in body depth, 2.5 to 2.8 times in stenderd length, dorsal profile near eye convex; snout moderetely short, its length about 1.8 to 2.4 times in head length, meesured without the lip the snout is 0.8 to 1.1 times in cheek height, its dorsal profile distinctly concave in large individuals and nearly straight in smaller individuals, snout angle relative to upper jaw between 55 and 70 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, closer to orbit then to enterior nostril; eye situated close to or far removed from the dorsal profile, its length 3.2 to 5.0 times in head length; cheek moderately high, its length 2.0 to 3.3 times in head length; leteral teeth in jaws conical; outer surface of mexille smooth or with a longitudinel ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2 4 to 3.4 times in body depth; anal fin with 3 spines and 8 soft rays, the third, fourth or fifth soft ray usually the longest, its length much longer than the length of the base of the soft-rayed portion of the anal fin and 0.9 to 1.2 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membrenes between the rays closest to the body with or without dense melenophores Laterel-line scales usuelly 47 or 48; cheek without sceles; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 to 17 scele rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of sceles around caudel peduncle; 5 to 7 sceles in supratemporal patch; inner surface of pectorel fin densely covered with scales; posterior engle of operculum fully scaled. **Colour:** body brown derk grey, with indistinct scattered smell derk end light spots, with irregular light stripes sometimes on lower sides; head brown or grey, often with many small orange spots on cheeks in small adults; pectoral and pelvic fin white to orangish, dorsal and anal fin mottled orange and bluish; caudal fin often bright orange, especially in subadults.

Geographical Distribution: Western Indian Oceen to the Centrel Pecific, from East Africa, Seychelles, Chagos end Meldives, to Theilend, Philippines, Ryukyus, Micronesia, northeestern Australia, Semoa, Society Islands and Tuamotus (Fig 114); previously recorded only as far east as Semoa, I heve exemined specimens of this species from Tehiti and the Tuemotus

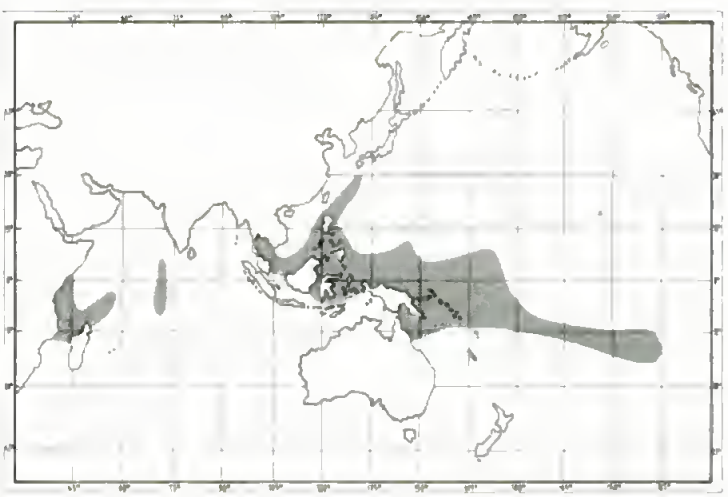


Fig. 114

Habitat and Biology: Inhabits deep lagoons and channels, and outer reef slopes and adjacent soft-bottom areas at depth of 20 to 120 m. It feeds mostly on echinoderms, crustaceans and molluscs.

Size: Maximum totel length to 70 cm, common to 50 cm total length.

Interest to Fisheries: Caught by handline, vertical longline, traps and trawls. Marketed mostly fresh. This species was found to be ciguatoxic in the Marshall Islends.

Local Nemes: AUSTRALIA: Yellow-spotted emperor; JAPAN: Ama-kuchibi; KENYA: Chengu tuku-mwani; PHILIPPINES: Bakuktuk, Katambak; SEYCHELLES: Capitaine rouge; SOUTH AFRICA: Orange-spotted emperor; Orenjekol-keiser; TANZANIA: Changu, Changu tuku-mweni.

Litereture: All the following listed as *L. kallopterus*: Allen & Steene (1987); Masude et al. (1984); Myers (1989); Sato in Fischer & Bianchi (eds) (1984); Smith, J.L.B. (1959); Smith, M.M. (1986).

Remerks: The name *L. kallopterus* has long been epplied to this species but the description end menuscript drawing of *L. erythracanthus* is clearly diagnostic. In eddition, *L. cinnabarinus* Richerdson elso eppears to be synonymous with this species. See remarks below under *L. erythropterus* for a further explanetion concerning the taxonomy of this species.

Copyrighted material

Lethrinus erythropterus Valenciennes, 1830 | Fig 115, Plate IV, 21 | **LETH Leth 11**

Lethrinus erythropterus Valenciennes, 1830, in C. & V., 1830 Hist.nat poiss., 6: 313 (Ulea).

Synonyms: ***Lethrinus striatus*** Steindachner (1866); ***Lethrinus hypselopterus*** Bleeker (1873)

FAO Names: En - Longfin emperor.

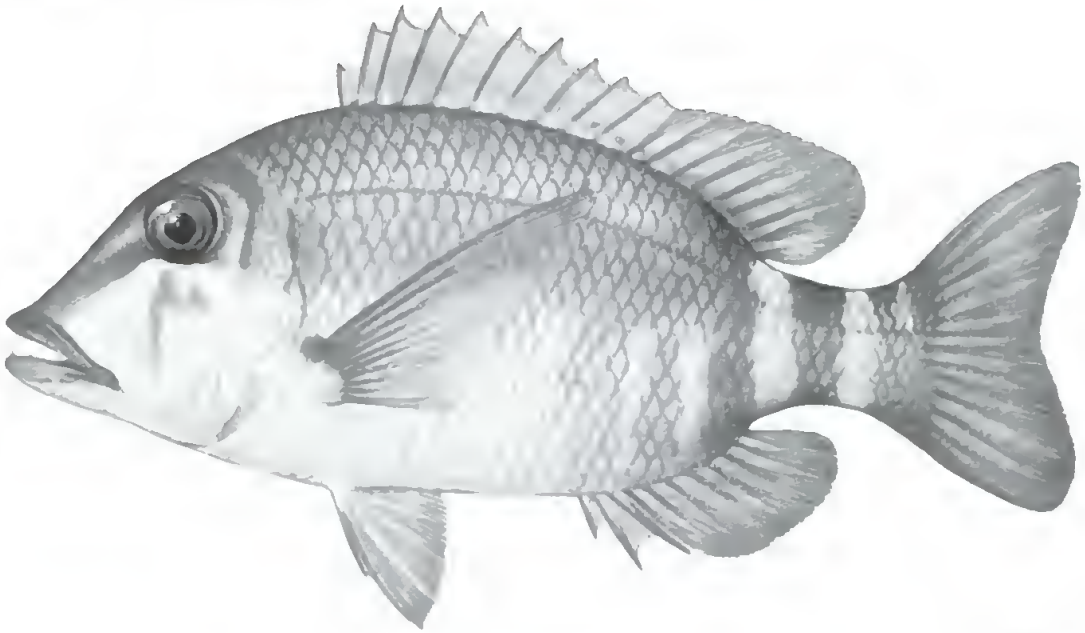


Fig. 115

Diagnostic Features: Body fairly deep, its depth 2 3 to 2 6 times in standard length. Head length 0 8 to 0.9 times in body depth, 2.5 to 2 8 times in standard length, dorsal profile near eye distinctly convex; snout moderately short, its length about 1 9 to 2 2 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile distinctly concave, snout angle relative to upper jaw between 55 and 60 degrees; interorbital space convex or almost flat; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close to or slightly removed from the dorsal profile, its length 3 6 to 4 6 times in head length; cheek moderately high, its length 2 1 to 2 6 times in head length; lateral teeth in jaws of adults molars or rounded; outer surface of maxilla usually smooth. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2.8 to 3.3 times in body depth; anal fin with 3 spines and 8 soft rays, the third, fourth or fifth soft ray usually the longest, its length much longer than the length of the base of the soft-rayed portion of the anal fin and 0 9 to 1.0 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores Lateral-line scales 44 to 46; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 5 to 9 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour:** head and body brown or rust red, lighter ventrally; sometimes two light bars on caudal peduncle; area around eye, a broad streak from eye to tip of snout, lips, and base of pectoral fin red; all fins reddish, often a bright red or orange

Geographical Distribution: Western Indian Ocean and West Pacific; Tanzania and Mozambique, Chagos, Celebes, the Philippines, Papua New Guinea, Palau, and Caroline Islands (Fig. 116).

Habitat and Biology: Inhabits mostly coral reefs and adjacent sandy areas. Occurs singly or in small groups. Feeds on echinoderms, molluscs, crustaceans and small fish.

Size: Maximum size to around 50 cm total length, commonly around 30 cm.

Interest to Fisheries: Limited interest to fisheries in the countries where it occurs. Caught mostly by handlines and traps. Marketed fresh.

Local Names: JAPAN: Kuchibeni-fuefuki; PHILIPPINES: Batilya, Katambak; SOUTH AFRICA: Mozambique emperor, Mosambiekse keiser

Fig. 116

Literature: The following listed as *L. hypselopterus*: Gloerfelt-Tarp & Kailola (1984); Myers (1989); Sato in Fischer & Bianchi (eds) (1984); Smith (1986)

Remarks : The name *L. hypselopterus* has long been applied to this species. There are however, two older names: *L. erythropterus* Valenciennes and *L. striatus* Steindachner. There is no type specimen for *L. erythropterus*, the description was based on a painting by the explorer, Mertens. Valenciennes made a copy of this painting and described the colours in the "Histoire naturelle des poissons" (1830). The description of the colours of the fins alone in Valenciennes' account are sufficiently diagnostic to demonstrate that this is the same species as *L. hypselopterus*. The drawing in Valenciennes' manuscript confirms this; no other species of *Lethrinus* of the specimen size stated has the fin colours and snout profile other than "*hypselopterus*". Sato (1978) placed both *L. erythropterus* and *L. erythracanthus* as synonyms of *L. kallopterus*. It is true that "*kallopterus*" has a similar fin colour, although this is typically mottled bluish as is clearly indicated in the description and manuscript painting of *L. erythracanthus*. The fin colour of "*hypselopterus*" is typically all red with dark red or brown blotches on the basal fin membranes; this is depicted in the manuscript painting and in the description. Moreover, the snout profile is straight in the painting of *L. erythracathus*, which is also characteristic of "*kallopterus*" of the specimen size stated while "*hypselopterus*" has a concave snout profile, also shown in the painting of *L. erythropterus*. It is clear that Mertens did in fact recognize and paint two distinct species.

Steindachner's (1866) description and drawing of *L. striatus* also is clearly diagnostic of the species that has long been called "*hypselopterus*". His drawing shows the long dorsal and anal soft rays and a slightly concave profile of the snout (*L. erythracanthus* has a concave profile of the snout only in very large specimens), that are typical of *L. erythropterus*. The description mentions molar teeth in the lateral jaws, and dark banding between the eyes and on the snout that is characteristic of *L. erythropterus*.

Sato (1978) placed the names *L. erythracanthus* and *L. erythropterus* in synonymy with *L. kallopterus* and designated the name *L. kallopterus* as the senior synonym, claiming that neither *L. erythracanthus* or *L. erythopterus* had been used for a long time. The current Code on Zoological Nomenclature no longer recognizes long periods of disuse as a justification for relegating a name to junior synonomy. It is possible to apply for conservation of the names "*hypselopterus*" and "*kallopterus*" based on an appeal of common use and disuse. The presence of two older names for "*hypselopterus*" and two older names for "*kallopterus*" makes this sort of appeal tenuous. For the sake of long-term stability in this difficult and confused genus, I choose to forego appeal and apply the simpler and more concrete rule of seniority.

Copyrighted material

Lethrinus genivittatus Valenciennes, 1830	Fig 117, Plate IV, 22	LETH Leth 6

Lethrinus genivittatus Valenciennes in C. & V., 1830 Hist nat poiss., 6: 306, pl. 159 (Indian Ocean).

Synonyms: *Lethrinus nematacanthus* Bleeker (1854c).

FAO Names: En - Longspine emperor

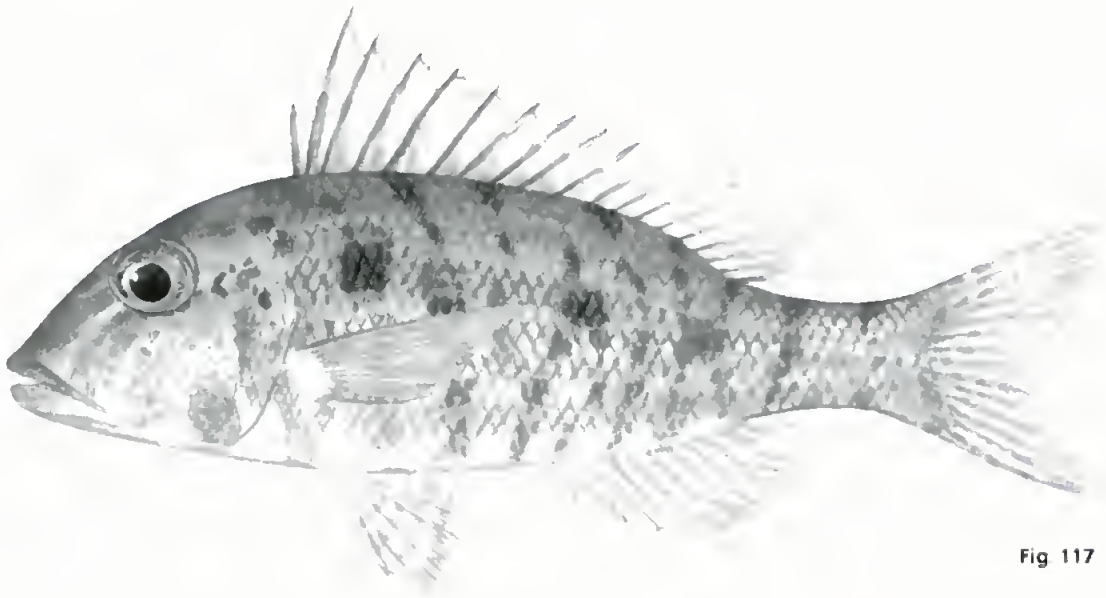


Fig. 117

Diagnostic Features: Body moderately slender, its depth 2.9 to 3.5 times in standard length. Head length 1.0 to 1.2 times in body depth, 2.8 to 3.0 times in standard length, dorsal profile near eye slightly convex; snout moderately short and blunt, its length about 2.3 to 2.5 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 60 and 70 degrees; interorbital space convex to flat; posterior nostril an oblong nearly vertical opening, about halfway between orbit and anterior nostril; eye situated close to dorsal profile, its length 3.6 to 4.0 times in head length; cheek not high, its length 2.6 to 3.1 times in head length; lateral teeth in jaws conical; outer surface of maxilla with a distinct knob. Dorsal fin with 10 spines and 9 soft rays, the second dorsal spine the longest, sometimes much longer than other dorsal spines, its length 1.3 to 1.9 times in body depth; anal fin with 3 spines and 8 soft rays, the first or second soft ray usually the longest, its length almost equal to or slightly shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 46 or 47; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 5 to 8 scales in supratemporal patch; inner surface of pectoral fin without scales, partially covered with scales or, densely covered with scales; posterior angle of operculum fully scaled. Colour: body tan or brown on upper sides, lower sides white with three brown or tan stripes, sides often with scattered irregular black oblique bars and a square black blotch above the pectoral fin and bordering below the lateral line; head brown or tan sometimes with several broad, somewhat indistinct vertical and oblique bands (the bands sometimes composed of fine reticulations); fins pale, speckled with small white blotches.

Geographical Distribution: Eastern Indian Ocean and Western Pacific, including Indonesia, northern Australia, the Philippines, southern Japan, Papua New Guinea and the Caroline Islands (Fig. 118).

Fig. 118

Habitat and Biology: Inhabits primarily shallow sandy and seagrass areas, and also found in mangrove swamps, lagoons, channels and outer reefs slopes at depths of 5 to 25 m; reportedly penetrates in rivers in some areas. Feeds mostly on crustaceans and small fish. A prolonged peak spawning period from July to December is reported in New Caledonia. Their eggs are spherical and pelagic with a diameter of 0.8 mm; hatching time is 1.6 days at a temperature of around 20 degrees centigrade. Significantly more and smaller females than males has been confirmed in populations in Australia.

Estimates of maximum age (t_{max}), asymptotic length ($L_{infinity}$), coefficient of growth (K), and rate of natural mortality (M) have been made for the population in New Caledonia: t_{max} = 7 years for both males and females, $L_{infinity}$ = 16.0 cm standard length for males and 14.0 cm standard length for females, K = 0.87 for males and 0.86 for females, and M = 1.82 for males and 1.87 for females.

Size: Maximum total length to around 25 cm, commonly to around 15 cm total length.

Interest to Fisheries: Caught mostly by shore seines. This species is of minor importance in fisheries due to its small average size. Marketed fresh.

Local Names: AUSTRALIA: Lancer; JAPAN: Ito-fuefuki; NEW CALEDONIA: Communard; PHILIPPINES: Kutot, Laway-laway, Lumo-an, Palutput.

Literature: The following listed as ***L. nematacanthus***: Fourmanoir & Laboute (1976); Gloerfelt-Tarp & Kailola (1984); Grant (1982); Masuda et al. (1984); Sainsbury et al. (1985).

Remarks : This species has long been recognized as ***L. nematacanthus*** and the name ***L. genivittatus*** misassociated with many other species. There are two characteristics of the type of ***L. genivittatus*** that have contributed to this misconception: (1) there are no scales in the pectoral axil and, (2) the second dorsal-fin spine is broken. The populations of "***nematacanthus***" that previous authors have worked with typically possess scales in the pectoral axil. I have examined several populations of this species and found the presence of pectoral axil scales to be variable. This accounts for the lack of scales in the pectoral axil of the type of ***L. genivittatus***. The most easily recognizable character of this species is the elongate second dorsal-fin and obviously, if this spine is broken, the species will not be readily recognizable. Despite the lack of the key character of the elongate second dorsal spine, I have confirmed the identity of this species using three separate characters and have examined the type of ***L. genivittatus*** on two separate occasions to confirm my diagnosis. The type of ***L. genivittatus*** has a distinctive knob on the surface of the maxilla. The only other species aside from "***nematacanthus***" that consistently has this distinctive knob is ***L. obsoletus*** but there are numerous other characters which confirm that ***L. genivittatus*** cannot be ***L. obsoletus***. The third dorsal spine becomes the longest dorsal spine in "***nematacanthus***" if the second dorsal spine is broken (in many cases there is not much difference in length of the second and third dorsal spine in specimens of this species), and this spine is elongate compared to other species of ***Lethrinus***. The ratio of the longest dorsal spine to body depth in the type of ***L. genivittatus*** is much less than all other species of ***Lethrinus*** (i.e. "***nematacanthus***" have generally longer dorsal spines) except perhaps ***L. variegatus***, and there are other characters which can confirm that ***L. variegatus*** is not the same as ***L. genivittatus***. The most convincing character that confirms ***genivittatus*** = ***nematacanthus*** is the shape of the canines in the anterior part of the lower jaw. In the type, these flare outward distinctively, such that the teeth noticeably protrude out of the mouth. In all other species of ***Lethrinus***, the teeth curve posteriorly and slightly outward (a little more perhaps in ***L. borbonicus***), but the outward flare is only noticeable on very large individuals. The type of ***L. genivittatus*** is 159 mm standard length and I have only observed a distinctive outward flare of the lower canines in specimens of "***nematacanthus***", never in specimens of other ***Lethrinus*** of comparable size to the type of ***L. genivittatus***. The smallest individuals of ***L. nematacanthus*** do not always exhibit this flare of the lower canines but it is consistently present in large specimens and individuals as small as about 100 mm standard length. The description and figure given by Valenciennes for ***L. genivittatus*** are consistent with this species, considering that the elongate second dorsal-fin spine of the type has been broken.

Lethrinus haematopterus Temminck & Schlegel, 1844 | Fig. 119, Plate IV, 23 | **LETH Leth 24**

Lethrinus haematopterus Temminck & Schlegel, 1844, Pisces, in Von Siebold, Fauna Japonica, 3:74, pl.38 (Japan).

Synonyms: ***Lethrinus richardsoni*** Gunther (1859)

FAO Names: En - Chinese emperor.

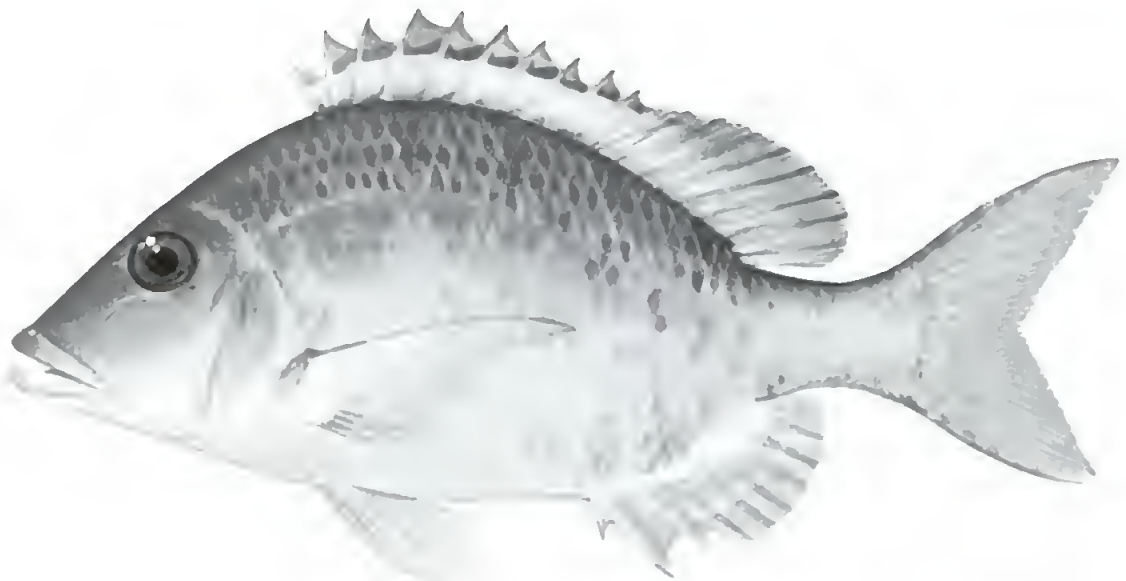


Fig. 119

Diagnostic Features: Body relatively deep, its depth 2.2 to 2 5 times in standard length. Head length 0.8 to 0 9 times in body depth, 2.6 to 2 9 times in standard length, dorsal profile near eye nearly straight; snout moderatly short, its length about 1.9 to 2 3 times in head length, measured without the lip the snout is 0.8 to 1.0 times in cheek height, it's dorsal profile nearly straight, snout angle relative to upper jaw between 60 and 70 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close or fairly removed from dorsal profile, its length 3 2 to 4 4 times in head length; cheek not very high, its length 2.4 to 3.0 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth or with a slight longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 2.8 to 3.7 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or slightly longer than the length of the base of the soft-rayed portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with or without dense melanophores. Lateral-line scales 47 to 49; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; 15 or 16 (usually 15) rows in lower series of scales around caudal peduncle; 5 to 8 scales in supratemporal patch; inner surface of pectoral fin base without scales; posterior angle of operculum fully scaled. **Colour:** body olive-grey with scattered irregular dark blotches; head grey, sometimes two blue stripes radiating forward from eye; fins pale or grey, the dorsal with a reddish edge

Geographical Distribution: Restricted to waters around southern China and southern Japan (Fig. 120).

Habitat and Biology: Nothing is recorded for this species.

Size: Attains 45 cm total length.

Interest to Fisheries: Of minor importance to fisheries in China.

Local Names: CHINA: Tseen tsuy tso, Tseen tsuy la; JAPAN: Fuefuki-dai.

Literature: Lee (1986); Masuda et al. (1984); Shen (1984, as ***Gymnocranius griseus***, including 329-1a,b,c).

Remarks: Sato (1978) listed ***L. genivittatus*** as a senior synonym of this species but as explained above, ***L. genivittatus*** clearly is not attributable to this species. There has been some speculation that the Australian species ***L. laticaudis*** may be included with this species but there are trenchant morphological differences between them. This species is clearly distinct and restricted to the seas around China and southern Japan.

Fig. 120

Lethrinus harak (Forsskål, 1775)

Fig. 121, Plate IV, 24)

LETH Leth 2

Sciaena harak Forsskål, 1775 , Descrip Animal., :xi, 52 (Arabia).

Synonyms: ***Lethrinus azureus*** Valenciennes (1830); ***Lethrinus rhodopterus*** Bleeker, 1852; ***Lethrinus johnii*** Castelnau (1873); ***Lethrinus bonhamensis*** Gunther (1873); ***Lethrinus papuensis*** Alleyne & Macleay (1877); ***Lethrinus bleekeri*** Klunzinger (1884).

FAO Names: En - Thumbprint emperor

Fig. 121

Diegnostic Features: Body moderately deep, its depth 2 6 to 2 8 times in standard length. Head length 0.9 to 1.0 times in body depth, 2.7 to 3 0 times in standard length, dorsal profile near eye distinctly or slightly convex; snbut short and blunt, its length about 2.1 to 2 6 times in head length, meesured without the lip the snout is 0 9 to 1.0 times in cheek height, its dorsal profile neerly straight, snout angle relative to upper jew between 60 and 70 degrees; interorbital space convex or almost flat; posterior nostril a narrow longitudinal slit, closer to orbit than to anterior nostril; eye situeted close to dorsal profile, its length 3 6 to 4 2 times in head length; cheek not very high, its length 2.5 to 3.0 times in head length; lateral teeth in jaws of edults molers or rounded; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2.S to 3.1 times in body depth; anal fin with 3 spines end 8 soft reys, the first soft ray usually the longest, its length almost equal to or longer or shorter than the length of the base of the soft-rayed portion of the anal fin and 0 6 to 0.8 times in the length of the entire anal fin base; pectorel rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales usually 46 or 47; cheek without scales; usuelly S 1/2 but sometimes 4 1/2 scale rows between leteral line and base of middle dorsal fin spines; usuelly 1S scele rows in transverse series between origin of enal fin and lateral line; 13 or 14 rows in lower series of scales around caudal peduncle; 4 to 7 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour**: olive or grey above, shading to silvery white below; a lerge elliptical black spot, often broadly edged in yellow, on side directly below lateral line and centered at e verticel neer the posterior tip of the pectoral fin; sometimes light blue dots bordering lower rim of eye and around nostrils; pectorel, pelvic, dorsal end anal fin white to pinkish; caudal fin orenge or reddish; vertical fins sometimes lightly mottled or striped.

Geogrephicel Distribution: Indian Ocean and western Pacific, including the Red Sea, East Africa, Seychelles, Maldives, Sri Lanka, Andamens, Indonesie, the Philippines, southern Japan, northeast Australia, Papua New Guinea, the Caroline Islends, Solomons, Vanuatu, Fiji and Samoa (Fig 122).

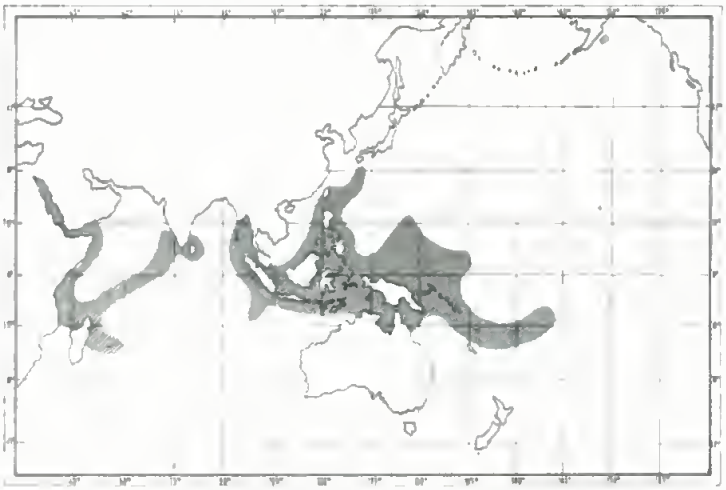


Fig. 122

Hebitat end Biology: Inhabits shallow sandy, coral rubble, mangroves, lagoons, chennel end seagrass areas inshore and adjacent to coral reefs. Feeds on polychaetes, crustaceans, molluscs, echinoderms and small fishes. Most often observed solitary but sometimes in small schools. Reported to spawn throughout the year during the first five days of the lunar month in large aggregations in legoons at Beleu. Meximum age reported for this fish is 1S years.

Size: Maximum total length to around 50 cm (elthough one unconfirmed report of over 60 cm), most commonly 20 to 30 cm total length.

Interest to Fisheries: Caught mostly by shore seines, gillnets, traps, and handlines. Marketed mostly fresh.

Local Nemes: AUSTRALIA: Thumbprint emperor; BELAU: Itotch; GUAM: Black-blotch emperor, Mafuti; JAPAN: Mato-fuefuki; KENYA: Kawa, M'cha kufa; LACCADIVES: Filolu, Makarimas, Metti, Chuttommette; MAURITIUS: Batardé, Berri bâtard, Battadet, NEW CALEDONIA: Bossu teché; PAPUA NEW GUINEA: Gwasawa, Tabutu; PHILIPPINES: Bitilya, Kilawen, Katambak; SAMOA: Mata'ele'ele; SAUDI ARABIA: Blackspot emperor, Shaoor, Sheiry; SEYCHELLES: En-bas-la-cendre, Lascar creole, Portreit; SOMALIA: Gehash-el-hereq, Gehesh me hereq, Sinagub; SOUTH AFRICA: Blackspot emperor, Swarkol-keiser; TANZANIA: Changu doa, Changu kabaka, Changu kidra, Changu kole, Changu ndizi, Kibaba; YEMEN: Gahesh herek

Literature: Allen & Steene (1987); Amesbury & Myers (1982); Gloerfelt-Tarp & Kailola (1984); Lee (1986); Masuda et al. (1984); Myers (1989); Randall (1983); Sato in Fischer & Bianchi (eds) (1984); Schroeder (1980, as *L. rhodopterus*); Smith (1959); Smith (1986)

Remerks: Sato (1978) expressed doubt about the identity of *L. ezureus* Valenciennes. Despite the ebsence of the derk leterel spot, the combinetion of characters unique to *L. harak* ere reedily recognizeble on the type of *L. azureus*. The dark lateral spot is very persistent in meny but not ell old specimens of *L. herak* end, this spot is sometimes only barely visible on fresh specimens of this species

Lethrinus laticaudis Alleyne & Macleay, 1877 | Fig. 123, Plate V, 25 | LETH Leth 25

Lethrinus laticaudis Alleyne & Macleay, Proc Linn Soc. New South Wales, 1: 276, pl. 8, fig. 2 (Percy Island, Queensland).

Synonyms: ***Lethrinus fletus*** Whitley (1943); ***Lethrinus anarhynchus*** Postel (1965).

FAO Names: En - Grass emperor

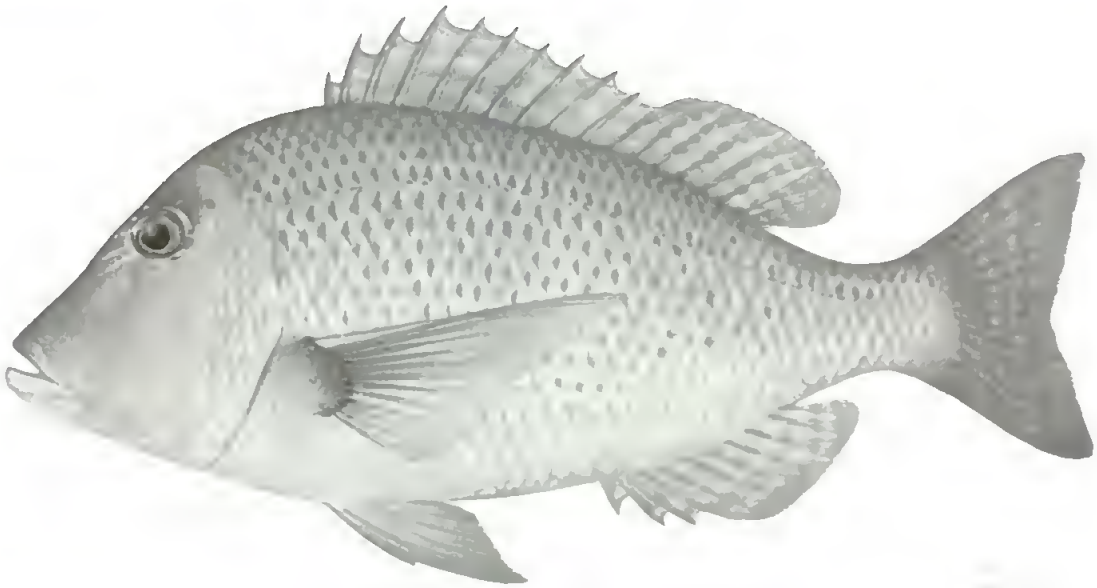


Fig. 123

Diagnostic Features: Body relatively deep, its depth 2.2 to 2.4 times in standard length. Head length 0.8 to 0.9 times in body depth, 2.7 to 2.9 times in standard length, dorsal profile near eye nearly straight or, concave in large individuals; snout length about 1.9 to 2.1 times in head length, measured without the lip the snout is 1.0 to 1.1 times in cheek height, its dorsal profile concave, snout angle relative to upper jaw between 60 and 70 degrees; interorbital space usually convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye removed from dorsal profile, its length 4.2 to 5.1 times in head length; cheek moderatly high, its length 2.2 to 2.5 times in head length; lateral teeth in jaws conical; outer surface of maxilla with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 3.0 to 3.4 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with or without dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 5 to 9 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour:** body tan, brown or yellow with scattered irregular dark blotches; head brown or yellow with blue dots on cheeks and short blue stripes radiating in front and behind eye, sometimes a number of blue cross stripes between the eyes; fins pale or yellow, the vertical fins mottled.

Copyrighted material

Geographical Distribution: Southern Indonesia, northwestern and northeastern Australia, Papua New Guinea and the Solomons (Fig. 124).

Habitat and Biology: Juveniles inhabit seagrass beds and mangrove swamps while adults are found mostly on coral reefs. Feeds mainly on crustaceans and fishes. Significantly more and smaller females than males has been confirmed in populations in Australia.

Size: Maximum reported total length reported as 56 cm, commonly from 30 to 40 cm total length.

Interest to Fisheries: Caught primarily by handlines. Mostly important as a sport fish and in handline fisheries in Australia. A good food fish. Marketed fresh.

Fig. 124

Local Names: AUSTRALIA: Grass sweetlip, Brown kelp-fish, Coral bream, Grey sweetlip, Piggy, Red-throat, Red-finned emperor, Snapper bream; JAPAN: Kamoguchi-fuefuki; PAPUA NEW GUINEA: Carri-carri.

Literature: Gloerfelt-Tarp & Kailola (1984, as *L. fraenatus*); Grant (1982, as *L. fletus*); Sainsbury et al. (1985, as *L. fraenatus*).

Remarks: There has been considerable confusion in the use of names for this species, most often in recent literature it is referred to as *L. fraenatus*, or *L. fletus*. The former name is clearly a junior synonym of *L. nebulosus* however and the latter a junior synonym of *L. laticaudis*; Walker (1975) was correct in his assesment of the earliest name for this species as *L. laticaudis*. I have been unable to confirm the presence of this species outside Indonesian or Australian waters. The name *L. anarhynchus* was used by Sato (1978) to represent this species, which was named by Postel (1965) from New Caledonia. There does not appear to be a type for *L. anarynchus* and the drawing and description in Postel's publication appears to be of an individual of *L. nebulosus* that has a distended belly due to an expanded air bladder, hence the deeper body profile. The specimen that Sato attributes to the name *L. anarynchus* is indeed *L. laticaudis*, but the specimen is from Australia, not a Postel specimen.

Lethrinus lentjan (Lacepède, 1802)

Fig. 125, Plate V, 26,27

LETH Leth 4

Bodianus lentjan Lacepède, 1802, Hist.nat.poiss., 4: 281, 293 (Java).

Synonyms: ***Lethrinus argenteus*** Valenciennes (1830); ***Lethrinus cinereus*** Valenciennes (1830); ***Lethrinus croceopterus*** Valenciennes (1830); ***Lethrinus flavescens*** Valenciennes (1830); ***Lethrinus geniguttatus*** Valenciennes (1830); ***Lethrinus mahsenoides*** Valenciennes (1830); ***Lethrinus opercularis*** Valenciennes (1830); ***Lethrinus virescens*** Valenciennes (1830); ***Lethrinus nubilis*** Cantor (1849); ***Lethrinus cocosensis*** Bleeker (1854a); ***Lethrinus glyphodon*** Günther (1859); ***Lethrinus fusciceps*** Macleay (1878).

FAO Names: En - Pink ear emperor.

Diagnostic Features: Body moderately deep, its depth 2.6 to 2.8 times in standard length. Head length 0.9 to 1.0 times in body depth, 2.6 to 3.0 times in standard length, dorsal profile near eye nearly straight; snout moderatly short, its length about 2.0 to 2.4 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 60 and 70 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close to or far removed from the dorsal profile, its length 3.9 to 4.8 times in head length; cheek not high, its length 2.5 to 3.0 times in head length; lateral teeth in jaws either rounded, rounded with tubercles, simple molars or molars with tubercles; outer surface of maxilla with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 2.7 to 3.4 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or shorter than the length of the base of the soft-rayed

Copyrighted material

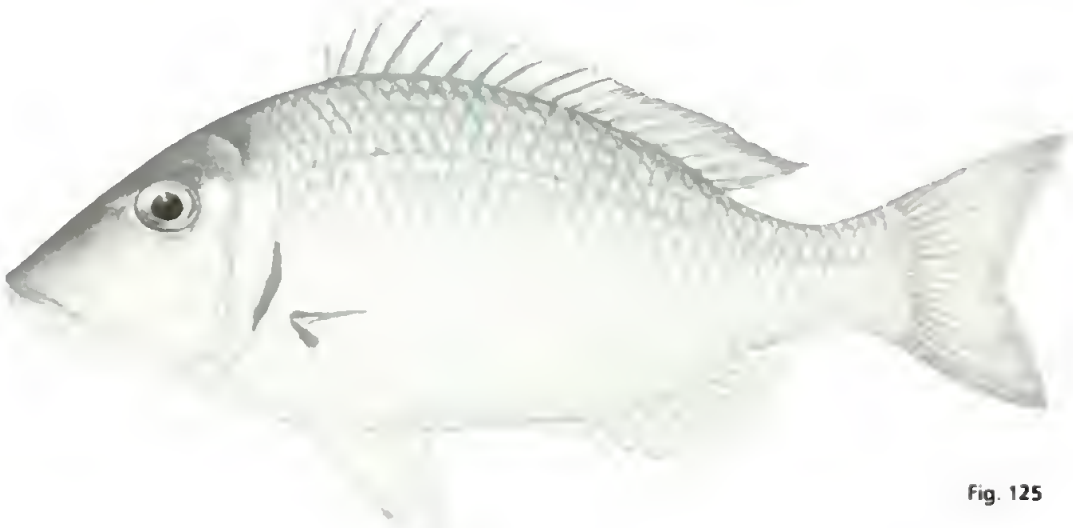


Fig. 125

portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales usually 46 or 47; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 4 to 9 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales, with a few scales or, naked; posterior angle of operculum fully scaled. **Colour**: body greenish or grey, shading to white below, centers of scales on upper sides often white; posterior margin of opercle and sometimes base of pectoral fin red; pectoral fin white, yellow or pinkish; pelvic and anal fins white to orange; dorsal fin white and orange mottled with a reddish margin; caudal fin mottled orange or reddish.

Geographical Distribution: Widespread in the Indo-West Pacific, including the Red Sea, Arabian (Persian) Gulf, East Africa to the Ryukus and Tonga (Fig. 126).

Fig. 126

Habitat and Biology: Found over sandy bottom in coastal areas, deep lagoons and near coral reefs, to depths of around 50 m. Juveniles and small adults commonly in loose aggregations over seagrass beds, mangrove swamps and shallow sandy areas while adults are generally solitary and found in deeper waters. Crustaceans and molluscs are the primary food item but echinoderms, polychaetes and fishes are also consumed in considerable quantities.

Peaks in spawning have been reported in January, April and May in the Red Sea, from December to February and June to August in southern India and, from September to December in New Caledonia. Size and age at maturity were found to be 30 cm standard length and three years respectively in India. Average length at 50% maturity was determined at 3.8 years in the Red Sea. A single female is estimated to release between 12,000 and 78,000 eggs per year. Spawning in Belau is reported to take place during the first half of the lunar month. Significantly more and smaller females than males have been observed in populations in Australia.

Maximum observed age (t_{max}), asymptotic length ($L_{infinity}$), coefficient of growth (K) and, rate of natural mortality (M) have been determined for a number of populations of ***L. lentjan***. In the Red Sea these were calculated as: t_{max} = 9 years, $L_{infinity}$ = 51.1 cm TL, K = 0.17 and, M = 0.42. In southern India, estimates were: t_{max} = 5 years, $L_{infinity}$ = 64 cm total length and, K = 0.27. In New Caledonia these were estimated as: t_{max} = 11 years, $L_{infinity}$ = 29.2 cm standard length, K = 0.33 and, M = 0.82. The weight-length relationship was determined as $W\ (g) = 0.0107 * L^{3.0904}$ (L = standard length in cm) for the Red Sea population.

Copyrighted material

Size: Maximum size to about 50 cm total length, commonly to around 30 cm total length.

Interest to Fisheries: Caught primarily by handlines, traps, trawls, beach seines, and gillnets. Marketed mostly fresh. An important fishery resource in some areas. In Saudi Arabia, this species claims the highest market price for finfish. In Tuwwal, Saudi Arabia, separate catch statistics have been gathered for this species; annual totals for 1981 and 1982 were 21.4 and 28.4 tonne respectively. This catch represented 8.1% and 9.8% respectively of the total landings for the area and a stock assessment indicated that the stocks were fully exploited.

Local Names: AUSTRALIA: Pink-eared emperor, Purple-eared emperor; BELAU: Metngui; INDIA: Pig-face bream; JAPAN: Shimofuri-fuefuki; KUWAIT: Sheiry; MADAGASCAR: Tsangou; PAPUA NEW GUINEA: Dragi, Gwasawa; PHILIPPINES: Batilya,Kilawan, Katambak; SAUDI ARABIA: Shaoor, Sheiry; SOUTH AFRICA: Redspot emperor, Rooikol-keiser; TANZANIA: Changu, Changu n'jana.

Literature: Gloerfelt-Tarp & Kailola (1984); Grant (1982); Lee (1986, as *L. mahsenoides* and *L. lentjan*); Masuda et al. (1984); Randall (1983); Sainsbury et al. (1985); Schroeder (1980); Smith (1959, 1986).

Remarks: There has been speculation that *L. opercularis* should be recognized as a separate species because it lacks scales in the pectoral axil and does not have a red mark on the base of the pectoral fin. I have examined hundreds of fresh specimens of the '*opercularis*' and '*lentjan*' forms in the Philippines, Thailand, and the Arabian Gulf and, looked at museum specimens from many localities. There are no consistent differences in red markings as all populations observed had a red posterior margin of the opercle and usually but not always a red mark at the base of the pectoral fin. There are consistent differences in scalation of the pectoral axil for different location within this species. *Lethrinus lentjan* populations around the Indian Ocean most frequently have the axil of the pectoral fin densely scaled. In the Philippines, the pectoral axil is most frequently naked, sometimes with a few scales in the lower part of the axil. In eastern Australia it is variable, specimens having a densely scaled, partially scaled or a naked pectoral axil. All other characters are constant between populations of *L. lentjan*. The allopatric differences in pectoral axil scalation appear to be population variation.

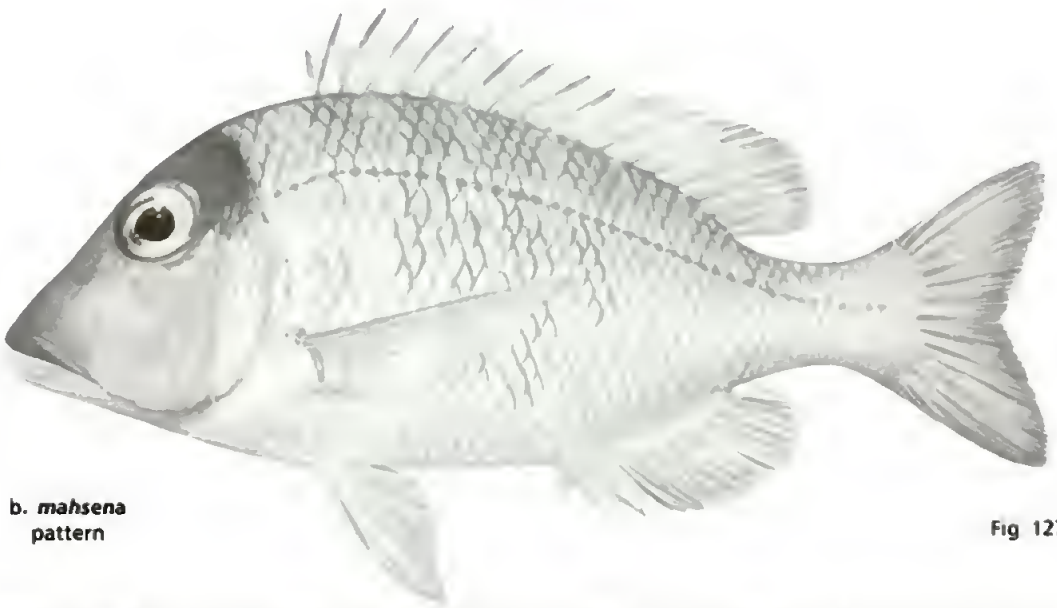
Lethrinus mahsena (Forsskål, 1775) Fig. 127, Plate V, 28,29 **LETH Leth 12**

Sciaena mahsena Forsskål, 1775, Descrip. Animal., :xi, 52 (Arabia).

Synonyms: *Lethrinus abbreviatus* Valenciennes (1830); *Lethrinus caeruleus* Valenciennes (1830); *Lethrinus sanguineus* Smith (1955)

FAO Names: En - Sky emperor

a. *sanguineus* pattern



b. *mahsena* pattern

Fig 127

Diagnostic Features: Body relatively deep, its depth 2 3 to 2.5 times in standard length. Head length 0.8 to 0.9 times in body depth, 2.7 to 2 9 times in standard length, dorsal profile near eye nearly straight; snout moderatly short, its length about 1.7 to 2.3 times in head length, measured without the lip the snout is 1.0 to 1.1 times in cheek height, its dorsal profile nearly straight or slightly concave, snout angle relative to upper jaw between 60 and 80 degrees; interorbital space convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril or slightly closer to anterior nostril than to orbit; eye situated close to or removed from the dorsal profile, its length 3.3 to 5.5 times in head length; cheek high, its length 1 9 to 2.5 times in head length; lateral teeth in jaws rounded or molars; outer surface of maxilla usually with a longitudinal ridge Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest, its length 2 9 to 3.8 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or greater than the length of the base of the soft-rayed portion of the anal fin and 0 7 to 0 8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with or without dense melanophores. Lateral-line scales usually 46 to 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 14 or 15 rows in lower series of scales around caudal peduncle; 3 to 6 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour**: head purplish grey, sometimes with a red blotch on nape; body yellow to greenish-blue, lighter ventrally, usually with nine or ten dusky yellow-green or brown bars; base of scales sometimes dark; a red bar at base of pectoral fin, sometimes extending broadly below and above pectoral fin base to edge of operculum; base of upper and sometimes lower rays of pectoral fin red; base and tips of pelvic fin often red; membranes of dorsal fin red (sometimes restricted to base of fin); anal fin whitish, with the membranes between the forward rays often red; caudal fin, especially the tips, reddish.

Geographical Distribution: Western Indian Ocean, including the Red Sea, East Africa to Sri Lanka (Fig. 128).

Habitat and Biology: Inhabits coral reefs and adjacent sandy and seagrass areas to depths of 100 m. Feeds primarily on echinoderms (most frequently sea urchins), crustaceans, and fishes; molluscs, tunicates, sponges, polychaetes and other worms are consumed in lesser quantities.

At Saya de Malha, this species was observed to be a protogynous hermaphrodite. Sex change was found to commonly occur between the ages of 5 and 6 years. Fecundity ranged between 26 700 and 166 200 eggs per mature female. Peaks in reproductive maturity were observed in October and November but this was variable depending on locality

Fig 128

Copyrighted material

Estimates of asymptotic length ($L_{infinity}$) and coefficient of growth (K) have been made for the Gulf of Aden: $L_{infinity}$ = 58 9 cm fork length and K = 0 32

Size: Maximum reported size 65 cm total length, commonly 35 to 45 cm total length

Interest to Fisheries: Caught mainly with handlines, traps, and trawls Considered an excellent food fish in most areas of the Red Sea but in some areas around the Indian Ocean it sometimes has an unpleasant 'coral' smell and taste Marketed mostly fresh. Considerably important in fisheries where it occurs. An important species in some fisheries. At Saya de Malha it is the main species fished by handlines (annual landings around 2 000 t).

Local Names: JAPAN: Iso-fuefuki; KENYA: Changu tuku; LACCADIVES: Filolu, Metti; MAURITIUS: Dame berri, Dame berri blanc; SAUDI ARABIA: Shaoor, Sheiry; SEYCHELLES: Lascar; SOUTH AFRICA: Sky emperor, Hemelkeiser; TANZANIA: Changu.

Literature: Randall (1983); Sato in Fischer & Bianchi (eds) (1984); Smith, J.L B. (1959); Smith, M.M (1986)

Remarks: The name ***L. sanguineus*** is sometimes applied to the form of this species with a bright red oblique streak from above to below the pectoral fin base I have examined the types of both ***L. mahsena*** and ***L. sanguineus*** and numerous specimens that have been recorded as one colour type or the other and can find no morphological differences between the two forms. Moreover, I have examined a number of colour photographs and find the red marking to be highly variable with intermediates between the 'red sash' (***sanguineus***) and the red pectoral base form (***L. mahsena***) The intensity of red on the fin membranes also waxes and wanes concommitantly with the intensity of the 'red sash' I have no definite hypothesis for the cause of variation in the red colour forms; variation could perhaps be due to a population, environmental or reproductive mechanism Because of the variation in colour and no apparent morphological differences, I recognize only one species.

Lethrinus microdon Valenciennes, 1830 | Fig 129, Plate V, 30 and Plate VI, 31 | **LETH Leth 14**

Lethrinus microdon Valenciennes in C. & V., 1830 Hist nat poiss., 6. 295 (Bourou).

Synonyms: ***Lethrinus elongatus*** Valenciennes, 1830; ***Lethrinus acutus*** Klunzinger, 1884; .

FAO Names: En - Smalltooth emperor

Fig 129

Diagnostic Features: Body relatively elongate, its depth 2.9 to 3.4 times in standard length. Head length 1.1 to 1.2 times in body depth, 2.6 to 3.0 times in standard length, dorsal profile near eye nearly straight; snout moderatly long, its length about 1.8 to 2.2 times in head length, measured without the lip the snout is 0.7 to 0.8 times in cheek height, its dorsal profile slightly concave, snout angle relative to upper jaw between 47 and 57 degrees; interorbital space convex to flat; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close to or removed from the dorsal profile, its length 4.0 to 6.2 times in head length; cheek not high, its length 2.7 to 3.4 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest, its length 2.4 to 3.0 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with or without dense melanophores. Lateral-line scales 47 or 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 9 to 11 (rarely fewer) scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour**: body bluish grey or brown often with scattered irregular dark blotches on sides; sometimes three dark streaks radiating forward from eye; fins pale or orangish.

Geographical Distribution: Wide-spread in the Indo-West Pacific, including the Red Sea, Arabian (Persian) Gulf, East Africa to Sri Lanka, to the Ryukyu Islands and Papua New Guinea (Fig. 130).

Fig. 130

Habitat and Biology: Inhabits sandy areas near coral reefs to depths of around 80 m. Swims in small schools, sometimes together with ***Lethrinus olivaceus***. Feeds primarily on fish, crustaceans, cephalopods and polychaetes during both night and day. Spawning in Belau occurs throughout most of the year, during the first five days of the lunar month, near the edge of reefs.

Estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K) and rate of natural mortality (M) have been made for the population in the waters around Djibouti: $L_{infinity}$ = 82 cm total length, K = 0.213, and M = 0.4.

Size: Maximum size to around 70 cm, commonly 30 to 50 cm total length.

Interest to Fisheries: Caught mostly with handlines, traps, gill nets and trawls. An excellent food fish. Marketed mostly fresh.

Local Names: BELAU: Mechur; JAPAN: Oo-fuefuki; KENYA: Nyavi, Nyamvi; MAURITIUS: Capitaine gueule longue; SAUDI ARABIA: Shoor, Sheiry; SEYCHELLES: Gueule longue; TANZANIA: Changu n'domo, Changu myamvi, Roba.

Literature: Gloerfelt-Tarp & Kailola (1984); Masuda et al. (1984); Randall (1983, as ***Lethrinus elongatus***); Shen (1984).

Remarks: The synonyms for this species are often confused with what is recognized here as ***L. olivaceus***. The cause of this confusion is the misconception that the number of scales above the lateral line to the base of the middle dorsal spines is variable in ***L. olivaceus***. I find that this character is very consistent but that snout length varies allometrically; there is considerable overlap in the ratio of length of snout from anterior nostril measured without the lip, to cheek length, between species of ***L. microdon*** and ***L. olivaceus***, depending on the overall size of the specimen examined. Another character which I have found useful (but not 100% reliable) in confirming the identity of this species is the number of scales in the supratemporal patch. There are usually 9 to 11 of these in ***L. microdon*** and 7 or 8 in ***L. olivaceus*** (Table 8).

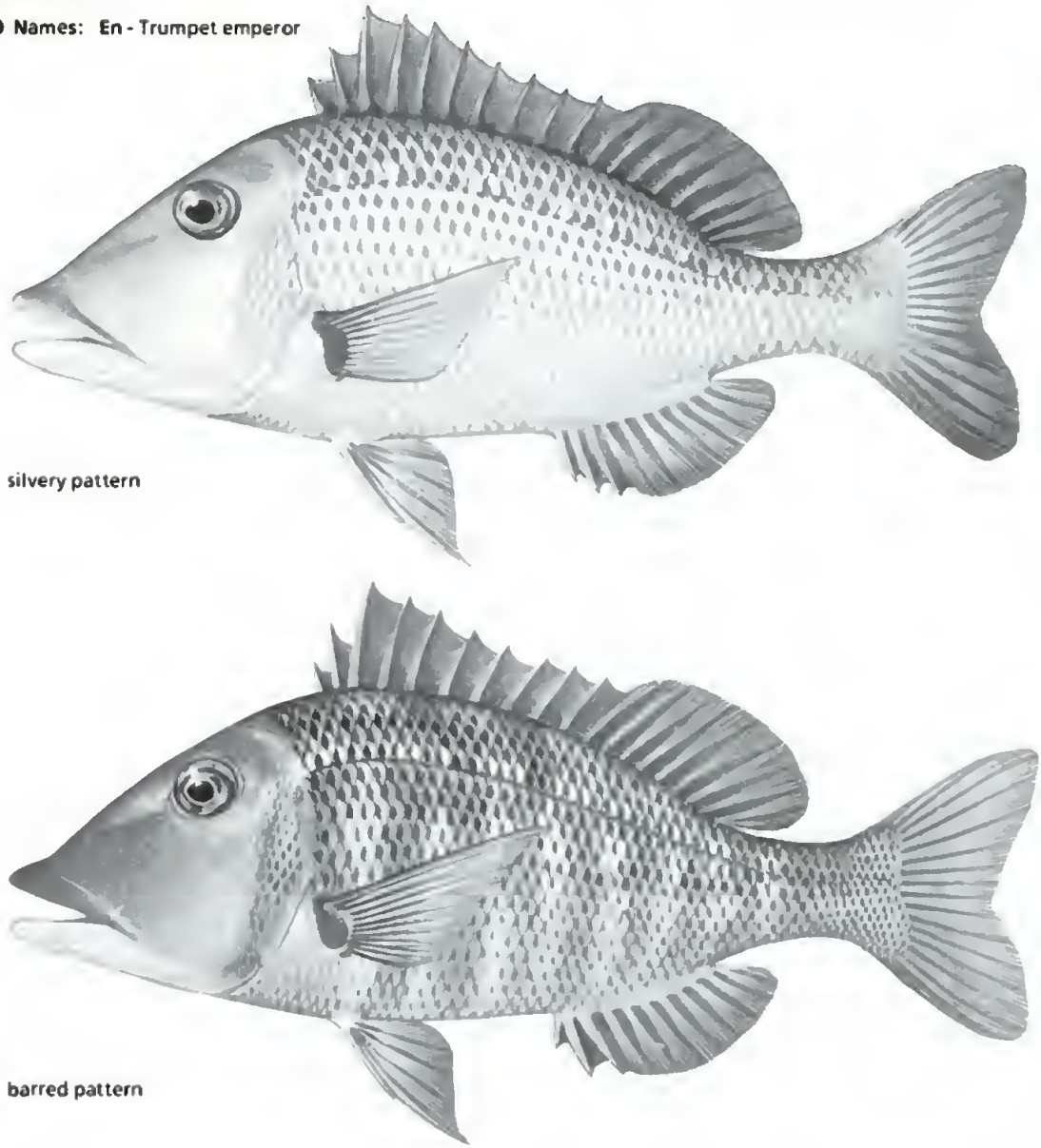
Lethrinus elongatus is the same species as ***L. microdon*** and would seem to have page priority over ***L. microdon***. As first revisors however we choose the name ***L. microdon*** to take precedence, since it has been used more often in the literature (Randall and Wheeler have a paper currently in press that follows this same precedence).

Lethrinus miniatus (Schneider, 1801) | Fig 131, Plate VI, 32-34 | **LETH Leth 26**

Sparus miniatus Schneider in Bloch & Schneider, 1801, Syst Ichthy , : 281 (New Caledonia).

Synonyms: ***Lethrinus chrysostomus*** Richardson (1848); ***Lethrinus imperialis*** DeVis (1884a); ***Lethrinus amamianus*** Akazaki (1962).

FAO Names: En - Trumpet emperor



a. silvery pattern

b. barred pattern

Fig 131

Diagnostic Features: Body fairly deep, its depth 2.4 to 2 8 times in standard length. Head length 0.9 to 1.0 times in body depth, 2 6 to 2 9 times in standard length, dorsal profile near eye slightly convex; snout moderatly long, its length about 1.8 to 2 2 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile slightly concave, snout angle relative to upper jaw between 50 and 65 degrees; interorbital space convex to flat; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 4 0 to 5 4 times in head length; cheek moderatly high, its length 2.1 to 2 9 times in

head length; lateral teeth in jaws conical; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine usually the longest, its length 2.3 to 2.9 times in body depth; anal fin with 3 spines and 8 soft rays, the first or second soft ray usually the longest, its length almost equal to or slightly longer than the length of the base of the soft-rayed portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body usually with dense melanophores. Lateral-line scales 47 or 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 to 17 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 4 to 6 scales in supratemporal patch; inner surface of pectoral fin without scales, partially covered with scales or, densely covered with scales; posterior angle of operculum fully scaled. **Colour**: body silvery, tan or yellowish, the base of scales often black, often a series of eight or nine dark bars; base of pectoral fin red; sometimes a red streak originating on upper operculum, passing beneath eye and on to snout; two red spots often on upper rim of eye; lips reddish; fins pale or reddish, sometimes brilliant red on membranes near base of pelvic fin, and between spinous rays of dorsal and anal fin.

Geographical Distribution : Northern Australia, Coral Sea and New Caledonia, and the Ryukyu Islands (Fig. 132).

Fig 132

Habitat and Biology: Inhabits coral reefs during the daytime where it feeds occasionally in sand and rubble areas between coral heads. At night-time they move out over the sandy sea floor sourrounding the reef and forage actively. Found at depths between 5 and 30 m, usually in small schools. The major food items are crustaceans, echinoderms, molluscs and fish, with crabs and sea urchins predominating. This species spawns annually between July and August in Australia. Mean maximum egg diameters are recorded as 0.91 mm in the breeding season. A predominance of females and average smaller size of females than males have been observed in the Australian population. Sexual maturity is reached between the ages of two and three years.

Observations of maximum age (t_{max}), and estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K), and rate of natural mortality (M) have been made for two populations. In Australia (Great Barrier Reef) they are: $L_{infinity}$ = 58.5 cm standard length, K = 0.17. In New Caledonia they are: t_{max} = 22 years for males and 14 years for females, $L_{infinity}$ = 48.9 cm standard length for males and 45.7 cm standard length for females, K = 0.26 for males and 0.27 for females, and M = 0.60 for males and 0.63 for females. The weight-length relationship was determined as $W(g) = 0.1003^{*} L^{2.8125}$ (L = standard length in cm) for males and $W(g) = 0.2020^{*} L^{3.0904}$ (L = standard length in cm) for females in the Great Barrier Reef population.

Size: Maximum size reported to around 90 cm total length and about 9 kg.

Interest to Fisheries: Caught primarily by handlines or droplines. One of the favourite food and sport fishes around the Great Barrier Reef. ***Lethrinus miniatus*** has contributed around 4% to the total commercial catch of New Caledonia although it is occasionally implicated in case of fish poisioning (ciguatoxin). Around some of the islands of New Caledonia this species is regularly discarded because of the high frequency of toxic specimens. The dropline fishery at Norfolk Island is dominated by this species.

Local Names: AUSTRALIA: Red-throated emperor, Sweetlip, Lipper, Tricky snapper; NEW CALEDONIA: Gueule rouge; NORFOLK ISLAND: Sweetlip emperor, Trumpeter.

Literature: Listed as *L. chrysostomus*: Allen & Steene (1987); Burgess & Axelrod (1976); Coleman (1981); Grant (1982); Sainsbury et al. (1985).

Remarks: The name most frequently applied to this species has been *L. **chrysostomus*** and the name *L. **miniatus*** has most often been used for what is recognized here as *L. **olivaceus***. Randall & Wheeler (in press) examined the iconotype of *L. **miniatus*** and found the colour pattern incontrovertibly recognizable as the species previously recognized as *L. **chrysostomus***.

Lethrinus nebulosus (Forsskål, 1775)

Fig 133, Plate VI, 35, 36

LETH Leth 15

Sciaena nebulosa Forsskål, 1775, Descrip Animal : xi, 52 (Arabia)

Synonyms: ***Lethrinus choerorynchus*** Bloch & Schneider (1801); ***Lethrinus alboguttatus*** Valenciennes (1830); ***Lethrinus centurio*** Valenciennes (1830); ***Lethrinus erythrurus*** Valenciennes (1830); ***Lethrinus esculentus*** Valenciennes (1830); ***Lethrinus fasciatus*** Valenciennes (1830); ***Lethrinus fraenatus*** Valenciennes (1830); ***Lethrinus gothofredi*** Valenciennes (1830); ***Lethrinus karwa*** Valenciennes (1830); ***Lethrinus korely*** Valenciennes (1830); ***Lethrinus maculatus*** Valenciennes (1830); ***Lethrinus cyanoxanthus*** Richardson (1843); ***Lethrinus anatarius*** Richardson (1844); ***Lethrinus guntheri*** Bleeker (1873); ***Lethrinus aurolineatus*** Macleay (1883); ***Lethrinus scoparius*** Gilchrist & Thompson (1908); ***Lethrinus carinatus*** Weber (1913); ***Lethrinus devisianus*** Whitley (1929); ***Lethrinus perselectus*** Whitley (1933)

FAO Names: En - Spangled emperor.

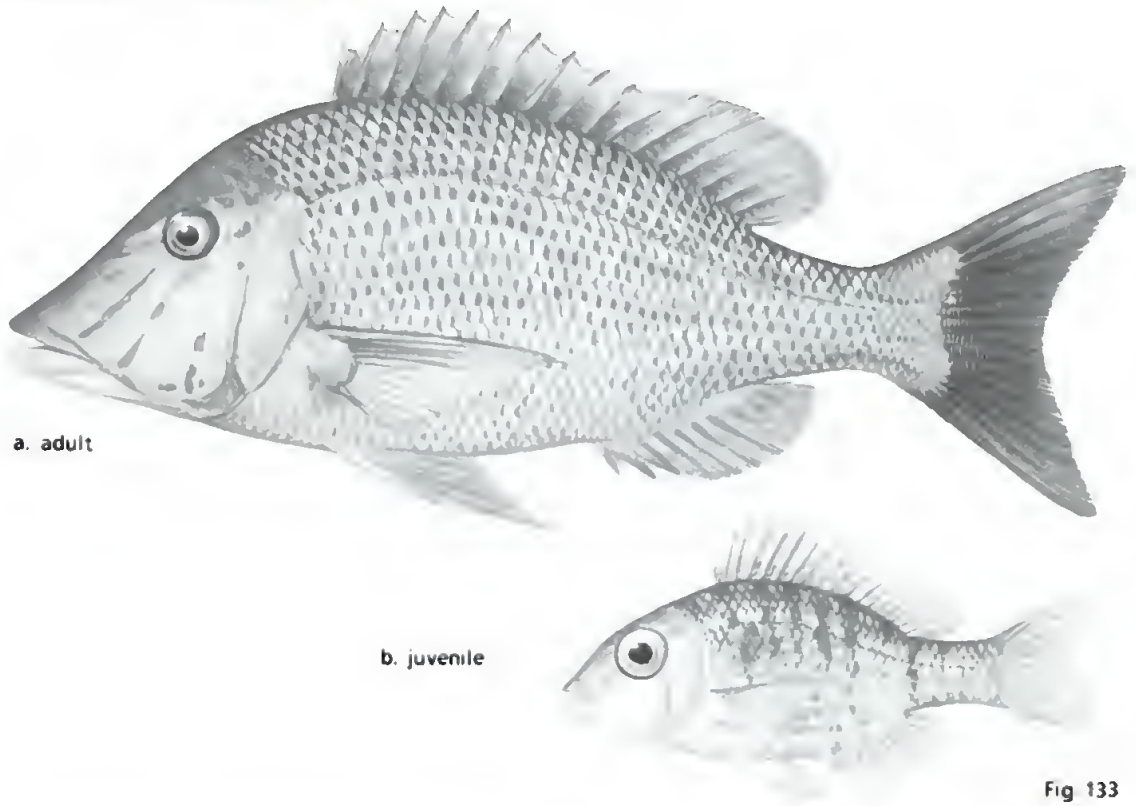


Fig 133

Diagnostic Features : Body moderately deep, its depth 2 5 to 2 8 times in standard length. Head length 0 9 to 1.0 times in body depth, 2 6 to 2 9 times in standard length, dorsal profile near eye nearly straight, or in large individuals, distinctly concave; snout moderatly long, its length about 1 8 to 2 3 times in head length, measured without the lip the snout is 0.8 to 1 0 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 50 and 65 degrees; interorbital space usually convex; posterior nostril an oblong longitudinal opening, closer to orbit than to anterior nostril or, about halfway between orbit and anterior nostril; eye removed from dorsal profile except in some small individuals it is situated fairly close to dorsal profile, its length 3.8 to 5 5 times in head length; cheek moderatly high, its length 2.6 to 3.0 times in head length; lateral teeth in jaws rounded with points or molars that often have tubercles; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine usually the longest, its length 2 8 to 3.5 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or slightly shorter than the length of the base of the soft-rayed portion of the anal fin and 0 6 to 0 8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body usually with dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 16 or 17 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 5 to 9 scales in supratemporal patch; inner surface of pectoral

fin densely covered with scales; posterior angle of operculum fully scaled. Colour: body yellowish or bronze, lighter below, centers of many scales with a white or light blue spot, sometimes irregular dark indistinct bars on sides and a square black blotch above pectoral fin bordering below the lateral line; three blue streaks or series of blue spots radiating forward and ventrally from eye; fins whitish or yellowish, the pelvic dusky, the edge of the dorsal fin reddish.

Geographical Distribution : Widespread in the Indo-West Pacific including Red Sea and Arabian (Persian) Gulf, East Africa to southern Japan and Samoa (Fig. 134).

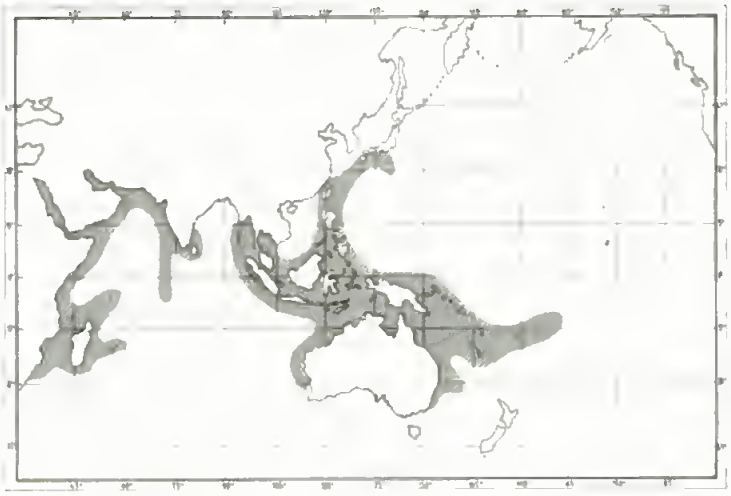


Fig. 134

Habitat and Biology: Inhabits nearshore and offshore coral reefs, coralline lagoons, seagrass beds, mangrove swamps and, coastal sand and rock areas, to depths of 75 m. Adults occur alone or in small schools; juveniles form large schools in shallow, sheltered sandy areas. Feeds primarily on echinoderms, molluscs and crustaceans, and to a lesser extent on polychaetes and fish.

Spawning activity has been reported to peak between April and July in the northern Red Sea, in March to May and September in the Gulf of Aden, between May and June in the northern Arabian (Persian) Gulf, in July and August in Australia and, between July and October in New Caledonia. Mean age at first sexual maturity was found as 4.6 years for males and 5.9 years for females in the northern Red Sea. In the northern Arabian (Persian) Gulf, maturity is reached at around age three for males and age four for females. Length of larval life was found to be 37 days (19.1 mm SL) for one individual that first settled on a coral reef of the Great Barrier Reef, Australia.

Estimates of maximum age (t_{max}), asymptotic length ($L_{infinity}$), coefficient of growth (K), and rate of natural mortality (M) have been made for a number of populations. In the northern Red Sea these are: $L_{infinity}$ = 86 cm total length, K = 0.11, M = 0.3. In the Gulf of Aden they have been estimated as: t_{max} = 21 years, $L_{infinity}$ = 71.6 cm fork length, 85.9 cm fork length, 87.0 cm fork length and 99.9 cm total length, K = 0.21, 0.101, 0.1 and 0.09, and M = 0.88 and M = 0.44. In the northern Arabian (Persian) Gulf they are: t_{max} = 20 years, $L_{infinity}$ = 62.7 cm total length, K = 0.19, and M = 0.36. In Papua New Guinea they are estimated as: $L_{infinity}$ = 54.7 and 55.8 cm fork length, K = 0.41 and 0.31, and M = 0.74 and 0.56. In Fiji they are: $L_{infinity}$ = 80.0 cm fork length, K = 0.23, M = 0.51. In New Caledonia they are: t_{max} = 24 years for males and 27 years for females, $L_{infinity}$ = 50.9 cm standard length for males and 54.3 cm standard length for females, K = 0.22 for males and .21 for females, and M = 0.54 for males and 0.51 for females. Length - weight relationships have been estimated as: total weight W (g) = 0.0173 $*L^{3.01}$ (L = total length in cm) in the Arabian (Persian Gulf) and, total weight W (g) = 0.0161 $*L^{2.97}$ (L = total length in cm) in the northern Red Sea.

Size: Maximum total length to around 80 cm, commonly between 20 and 50 cm total length.

Interest to Fisheries: Taken by handlines, traps, trawls, seines and gill nets. It is considered one of the best food fishes in many countries, although in a few areas in the Indian Ocean it is said to sometimes have a disagreeable coppery or iodine taste and smell. Marketed mostly fresh. A favorite sport fish in Kuwait and Australia because it is a powerful and determined adversary on a line. A very important commercial fish in some countries. In New Caldedonia it is the most important commercial fish, reported to comprise around 25% of the total commercial catch.

In Japan, research has been conducted that indicates this species may be used in aquaculture. In China, this species is being cultured in sea cages. It has been shown that *L. nebulosus* can survive for long periods in salinities as low as 10 parts per thousand and therefore it is a potential estuarine aquaculture species.

Local Names: AUSTRALIA: Spangled emperor, Sand snapper, Nor'-west snapper, Yellow sweetlip; JAPAN: Hamafuefuki; KENYA: Changu nyamvi, Tukwana, Kiuwa; KUWAIT: Sheiry; MAURITIUS: Créole, Capitaine créole, Capitaine; MOZAMBIQUE: Husutoni, Ladrao, Tsongue, Phelele; NEW CALDEDONIA: Bec de cane, Lethrinus nuageux; PAKISTAN: Gadeer, Mulla, Starry pigface bream; PHILIPPINES: Bitilya, Katambak, Kilawan; SAUDI ARABIA: Shaoor mehseny, Sheiry; SEYCHELLES: Capitaine rouge, Eclair; SOUTH AFRICA: Blue emperor, Blou keiser; SRI LANKA: Pulli vella meen, Vella meen; TANZANIA: Changu tewa, Changu m'zizi, Changu koko, M'changu.

Copyright FAO

Literature: Gloerfelt-Tarp & Kailola (1984); Fourmanoir & Laboute (1976); Grant (1982); Lee (1986); Masuda et al. (1984); Randall (1983); Sainsbury et al. (1985); Schroeder (1980); Smith, J.L.B. (1959); Smith, M.M. (1986)

Remarks: This species has had more names applied to it than any other lethrinid. It is widespread and very common throughout its range which is the perhaps the main reason for the long list of synonyms; it is easily recognizable both fresh and preserved.

See also remarks under *L. laticaudis*.

Lethrinus obsoletus (Forsskål, 1775) Fig. 135, Plate VI, 37 **LETH Leth 16**

Sciaena obsoleta Forsskål, 1775, Descrip Animal., :xi, 52 (Arabia)

Synonyms: *Sciaena ramak* Forsskål (1775); *Lethrinus cutambi* Seale (1909).

FAO Names: En - Orange-striped emperor

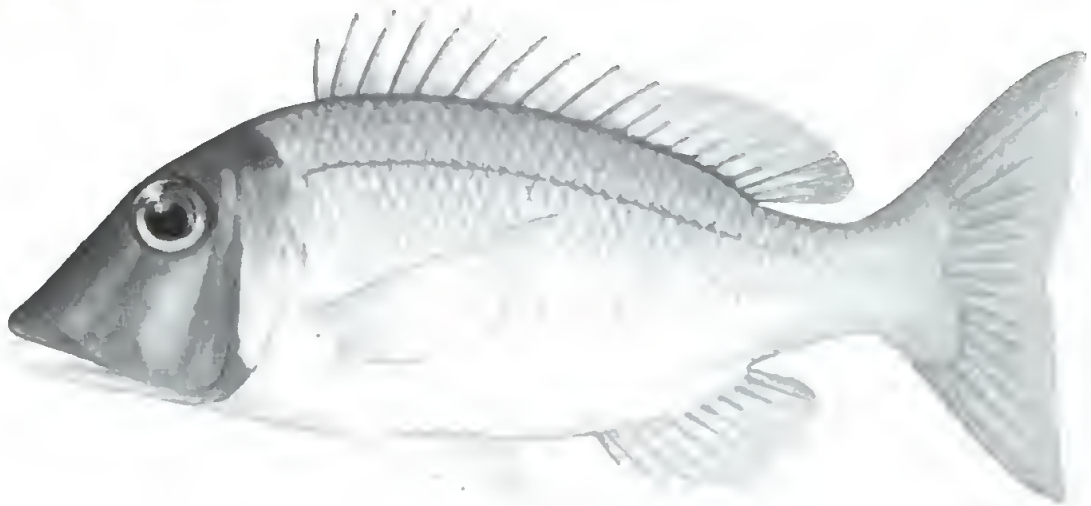


Fig. 135

Diagnostic Features : Body moderately deep, its depth 2.6 to 2.9 times in standard length. Head length 1.0 to 1.1 times in body depth, 2.6 to 2.9 times in standard length, dorsal profile near eye nearly straight or slightly convex; snout length about 1.8 to 2.3 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile slightly concave, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space convex; posterior nostril an longitudinal opening, closer to orbit than to anterior nostril; eye situated close to or removed from dorsal profile, its length 3.5 to 5.0 times in head length; cheek length 2.5 to 3.2 times in head length; lateral teeth in jaws conical or rounded; outer surface of maxilla with a distinct knob. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2.5 to 3.4 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length either almost equal to, longer, or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 45 to 48, cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; usually 5 to 7 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. Colour: body light tan or olive to brown, lighter below; centers of scales often lighter than background colour; an orange-yellow stripe on lower side at the level of the pectoral fin base, with two additional more faint orange-yellow stripes above and one below this stripe; head often with several broad indistinct vertical and diagonal light and dark bands; sometimes white spots below eye; posterior edge of operculum dark brown; fins whitish or tan, sometimes mottled.

Geographical Distribution : Widespread in the Indo-West Pacific including the Red Sea, East Africa to the Ryukyu Islands, Tonga and Samoa (Fig. 136).

Habitat and Biology: Inhabits seagrass beds, and sand and rubble areas of lagoons and reefs to depths of around 30 m. Feeds mostly on crustaceans, molluscs and echinoderms. In Belau it is reported to spawn at the outer reef edge on the first five days of the lunar month, from November through April. Maximum reported age for this species is 14 years.

Size: Maximum total length reported as 60 cm, commonly between 20 and 30 cm total length.

Interest to Fisheries: Caught mostly by traps and shore seines, occasionally by gillnets, handlines and trawls. Marketed mostly fresh.

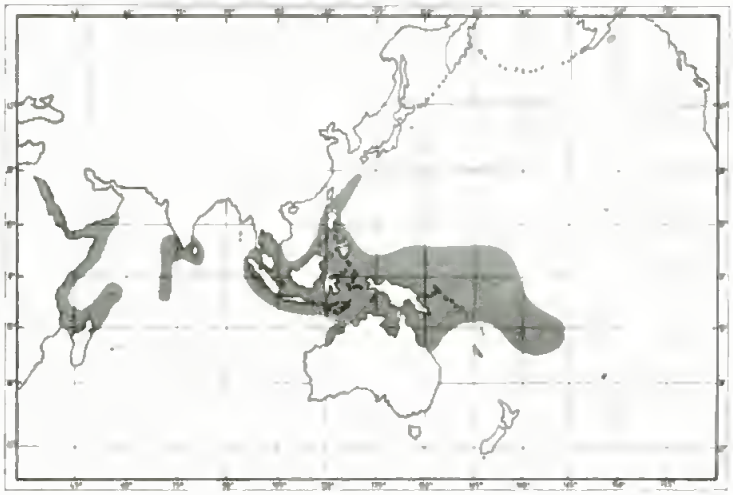


Fig. 136

Local Names: AUSTRALIA: Orange-striped emperor; BELAU: Chudch; JAPAN: Tateshima-fuefuki; LACCADIVES: Metti; NEW CALEDONIA: Bossu d'herbe; PHILIPPINES: Bitilya, Katambak, Kilawan; SAMOA: Magauli, Mailafo'u; SEYCHELLES: Dame berry, Lascar; SOUTH AFRICA: Orange-stripe emperor, Oranjestreep-keiser; SRI LANKA: Hini gadeya, Vella meen; TANZANIA: Changu, Njana.

Literature: Grant (1982); Masuda et al. (1984, as *L. ramak*); Myers (1989, as *L. ramak*); Schroeder (1980, as *L. variegatus*); Smith (1959); Smith (1986, as *L. ramak*).

Remarks: There has been doubt expressed as to the correct designation of the Forsskål type for this species. I have examined the type however, and found it to have the distinctive knob on the outer surface of the maxilla. There is little doubt that the type has been designated correctly.

The name *Lethrinus ramak* has most frequently been used for this species. Smith (1959) however, demonstrated that Forsskål intended the term 'ramak' as a listing of the common name and *obsoletus* was intended for the species name. The confusion occurred because Forsskål first included the name in a species list (page xii) as: "*Sciaena obsoleta*: flaveo-violaceo lineata. Ramak.", and subsequently described the species on page 52: "*Sciaena ramak, obsoleta*" and ends the description: "Arab. Ramak", with the name Ramak written with Arabic letters. The inclusion of '*ramak*' with the genus name was apparently a manuscript error. Despite the obvious manuscript error, the name *ramak* could still be construed as being available to represent this species. Both names could be considered available, and both names are in the same publication; therefore, according to the Code of Zoological Nomenclature, the first revisor should choose which name to use. Sato (1971, 1978) chose to use *L. ramak* based on the more common usage of this name, and because it had not been used for a period of 50 years. The Code of Zoological Nomenclature no longer recognizes this as a proper justification to relegate a name to junior synonymy. Smith was first revisor and his use of *L. obsoletus* should be followed.

Lethrinus olivaceus Valenciennes, 1830

Fig. 137, Plate VII, 38

LETH Leth 5

Lethrinus olivaceus Valenciennes in C. & V., 1830 Hist nat.poiss., 6: 295 (Java).

Synonyms: *Lethrinus rostratus* Valenciennes (1830); *Lethrinus waigiensis* Valenciennes (1830); *Lethrinus xanthopterus* (?) Valenciennes (1830); *Lethrinus longirostris* Playfair & Günther (1866); *Lethrinus rostratus specificus* Borodin, 1932.

FAO Names: En - Longface emperor.

Fig. 137

Diagnostic Features : Body moderately elongate, its depth 3.0 to 3.3 times in standard length. Head length 1.1 to 1.3 times in body depth, 2.4 to 2.9 times in standard length, dorsal profile near eye nearly straight; snout length about 1.8 to 2.0 times in head length, measured without the lip the snout is 0.65 to 0.7 times in cheek height, its dorsal profile slightly concave, in large individuals there is sometimes a hump on snout directly in front of the eye, snout angle relative to upper jaw between 40 and 50 degrees; interorbital space convex to flat; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to or removed from dorsal profile, its length 4.4 to 6.2 times in head length; cheek length 3.0 to 3.6 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest, its length 2.5 to 2.8 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length almost equal to or slightly shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 16 or 17 (usually 17) scale rows in transverse series between origin of anal fin and lateral line; 15 rows in lower series of scales around caudal peduncle; usually 7 to 9 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour:** body grey, lighter ventrally, often with scattered irregular dark blotches; snout with wavy dark streaks, upper jaw, especially near corner of mouth sometimes edged behind with red.

Geographical Distribution : Widespread in the Indo-West Pacific, including the Red Sea, East Africa to the Ryukyu Islands and Samoa (Fig. 138).

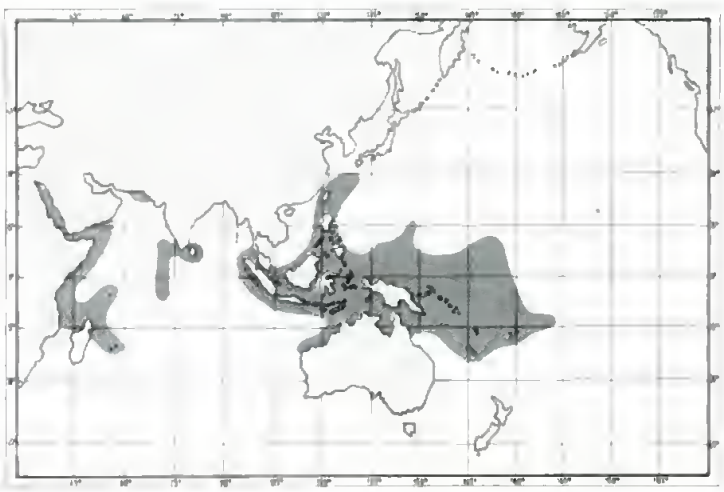


Fig. 138

Habitat and Biology: Inhabits sandy coastal areas, lagoons and reef slopes, occurring to depths of 185 m; juveniles are found in shallow sandy areas. Often occurs in large schools. Feeds mostly on fish, crustaceans and cephalopods. In Belau it spawns throughout the year on the first few days of the lunar month along the edges of reefs.

Estimates of asymptotic length ($L_{infinity}$), coefficient of growth (K) and rate of natural mortality (M) have been made for a population in Papua New Guinea: $L_{infinity}$ = 75.0 cm standard length, K = 0.25, and M = 0.59.

Size: Total length to 100 cm, commonly to 70 cm total length.

Interest to Fisheries: Caught mostly with handlines and traps, occasionally by trawls and gillnets. Large individuals are often ciguatoxic in New Caledonia, the Tuamotus, the Marquesas, the Marshall Islands, and possibly elsewhere in Oceania. It is the object of one of the most important fisheries in Belau where they are reportedly overfished. In both Belau and Tahiti this species is actively fished in locations and times known to have large spawning aggregations. Thirty-two specimens of this species from Mourea and the Marquesas were introduced to Hawaii in 1956 to enhance fisheries, but these apparently did not become established.

Local Names: AUSTRALIA: Long-nosed emperor; BELAU: Mlangmud; JAPAN: Kitsune-fuefuki; KENYA: Nyavi, Nyanvi; MAURITIUS: Kaya la gueule rouge; NEW CALEDONIA: Bec de cane malabar, Lethrinus à museau long; PAKISTAN: Gadeer, Mulla, Longnose pigface bream; PAPUA NEW GUINEA: Adia, Gawasa, Vanaka; PHILIPPINES: Batilya, Katambak, Kilawan, Sapingan; POLYNESIA: Aaravi, Guitora, Meko, Odeo uturoa, Tipuake; SEYCHELLES: Capitaine gueule longue; Gueule de vin; SOUTH AFRICA: Longnose emperor, Langneus-keiser; SRI LANKA: Hota ula, Palu hakka, Thinan, Ura hota; TANZANIA: Changu-mdomo, Changu, Roba.

Literature: Bagnis et al. (1972, as *L. miniatus*); Fourmanoir & Laboute (1976, as *L. miniatus*); Gloerfelt-Tarp & Kailola (1984, as *L. elongata*); Lee (1986, as *L. minutus*); Masuda et al. (1984 as *L. miniatus*); Myers (1989, as *L. elongatus*); Smith (1959, as *L. miniatus*); Smith (1986, as *L. elongatus*).

Remarks: The names most frequently applied to this species are *L. elongatus* and *L. miniatus*. As mentioned previously, the name *L. miniatus* properly belongs to the species most commonly called *L. chrysostomus*. I have examined the type of *L. elongatus* and it is undoubtedly the same species as *L. microdon*. Two, and possibly three other names are available for this species: *L. rostratus*, *L. waigiensis*, and possibly *L. xanthopterus*. The type of *L. olivaceus* is in excellent shape, while the types of *L. waigiensis* and *L. rostratus* are not, and there is no type specimen for *L. xanthopterus*. As first revisor, I choose the name *L. olivaceus* on the basis of page priority and the advantage of having a type specimen in good condition (this is also being followed in a paper currently in press by Randall and Wheeler).

Lethrinus ornatus Valenciennes, 1830

Fig. 139, Plate VII, 39

LETH Leth 7

Lethrinus ornatus Valenciennes in C. & V., 1830 Hist. nat. poiss., 6: 310 (Java).

Synonyms: ***Lethrinus xanthotaenia*** Bleeker (1851b); ***Lethrinus insulindicus*** Bleeker (1873).

FAO Names: En - Ornate emperor.

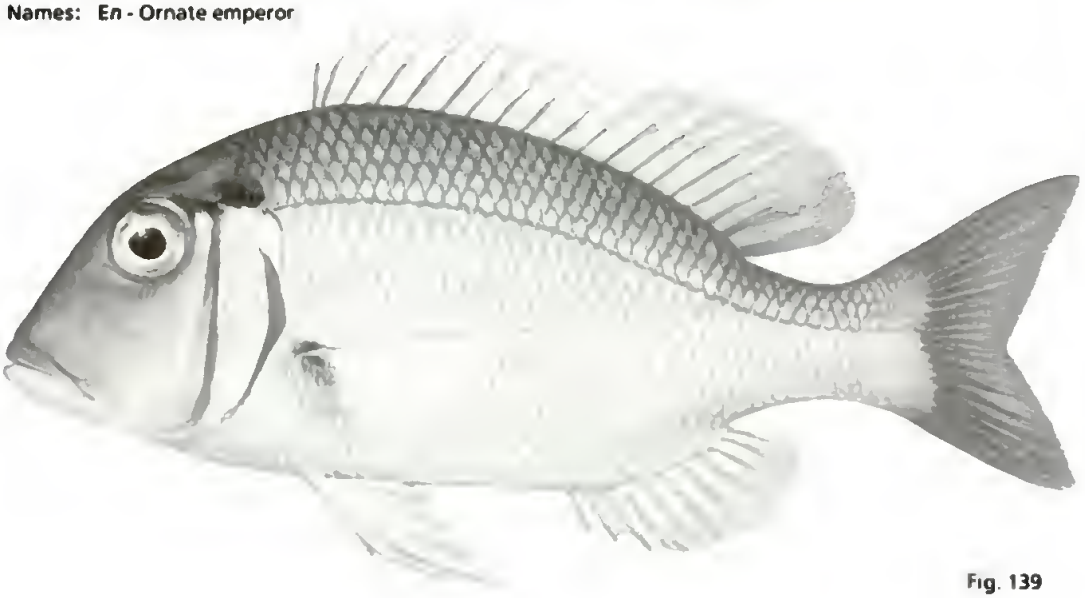


Fig. 139

Diagnostic Features: Body relatively deep, its depth 2.4 to 2.6 times in standard length. Head length 0.8 to 0.9 times in body depth, 2.7 to 3.0 times in standard length, dorsal profile near eye convex; snout length 2.0 to 2.5 times in head length, measured without the lip the snout is 0.9 to 1.0 times in cheek height, its dorsal profile nearly straight or slightly concave, snout angle relative to upper jaw between 65 and 75 degrees; interorbital space convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.4 to 3.7 times in head length; cheek length 2.3 to 2.9 times in head length; lateral teeth in jaws rounded with points or molars; outer surface of maxilla usually smooth, sometimes with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the fourth or fifth dorsal spine the longest, its length 2.7 to 3.2 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length longer than the length of the base of the soft-rayed portion of the anal fin and 0.7 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales usually 46 or 47; cheek without scales; 5 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; 13 to 15 rows in lower series of scales around caudal peduncle; usually 6 to 8 scales in supratemporal patch; inner surface of pectoral fin densely covered with scales; posterior angle of operculum fully scaled. **Colour:** body dusky whitish, lighter below, with four or six orange stripes; posterior edge of operculum and preoperculum bright red (the former more conspicuous); head brown or tan, sometimes a red spot on lower front edge of eye; pectoral fin orangish; pelvic, anal and most of dorsal fin whitish; edge of dorsal fin and caudal fin reddish.

Geographical Distribution: Eastern Indian Ocean and Western Pacific, from Sri Lanka to the Ryukyu Islands, Papua New Guinea, and Northeast Australia (Fig. 140).

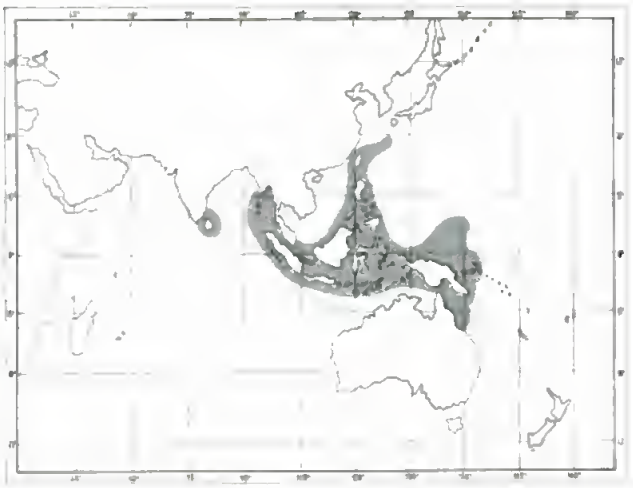


Fig. 140

Habitat and Biology: Inhabits sandy and soft bottoms and seagrass beds in inshore bays, lagoons and areas adjacent to reefs. Feeds on crustaceans, molluscs, echinoderms, polychaetes and small fishes.

Size: Maximum total length to 40 cm.

Interest to Fisheries: Caught by traps, handlines, shore seines, trawls and handlines. Of minor importance in fisheries where it occurs.

Local Names: Yellow-striped emperor; JAPAN: Hana-fuefuki; PAPUA NEW GUINEA: Daryya; PHILIPPINES: Bitilya, Katambak, Kilawan.

Literature: Gloerfelt-Tarp & Kailola (1984); Lee (1986); Masuda et al. (1984); Sato in Fischer & Bianchi (eds) (1984); Schroeder (1980).

Remarks: This is a distinctive species and has not been confused with other species in recent literature.

Lethrinus reticulatus Valenciennes, 1830

Fig 141, Plate VII, 40

LETH Leth 27

Lethrinus reticulatus Valenciennes in C. & V., 1830 Hist.nat.poiss., 6: 298 (New Guinea).

Synonyms: None.

FAO Names: En - Red snout emperor.

Diagnostic Features: Body moderately elongate, its depth 2.9 to 3.2 times in standard length. Head length 1.1 to 1.2 times in body depth, 2.5 to 2.8 times in standard length, dorsal profile near eye distinctly convex; snout length about 1.9 to 2.3 times in head length, measured without the lip the snout is contained 0.8 to 0.9 times in cheek height, its dorsal profile distinctly concave, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space flat or concave; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.3 to 4.3 times in head length; cheek length 2.7 to 3.3 times in head length; lateral teeth in jaws conical; outer surface of maxilla usually smooth. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine the longest, its length 2.0 to 2.8 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft

Copyrighted material

ray usually the longest, its length almost equal to, shorter or slightly longer than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 7 to 10 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour**: body olive-grey or tan, often with scattered irregular black blotches; base of pectoral, upper edge of operculum and sometimes posterior edge of preoperculum red; head brown or olive with a somewhat indistinct reddish band on snout, originating midway between eye and snout and terminating on tip of snout; lips red; fins pale or orangish.

Geographical Distribution: Chagos, West Thailand, Ryukyu Islands, the Philippines to New Guinea (Fig. 142).

Habitat and Biology: Nothing specific is reported on the habitat or biology of this species. It is thought to occur on soft bottoms near reefs. The diet presumably consists of benthic invertebrates and fish.

Size: Maximum size around 40 cm total length.

Interest to Fisheries: Caught mostly by trawls and handlines. Marketed fresh.

Local Names: JAPAN: Yaeyama-fuefuki; PHILIPPINES: Bitilya, Katambak, Kilawan.

Literature: Masuda et al. (1984).

Remarks: The type specimen of this species is small and it is difficult to compare the morphometrics of the type with the species being recognized here as *L. reticulatus*. The evidence available however, suggests that Sato (1978) was correct in assigning this name to the present species.

Fig. 142

Lethrinus rubrioperculatus Sato, 1978 | Fig 143, Plate VII, 41 | **LETH Leth 17**

Lethrinus rubrioperculatus Sato, 1978, Univ Mus., Univ Tokyo Bull., 15:58, pl. 12, fig. A (Okinawa)

Synonyms: None

FAO Names: En - Spotcheek emperor.

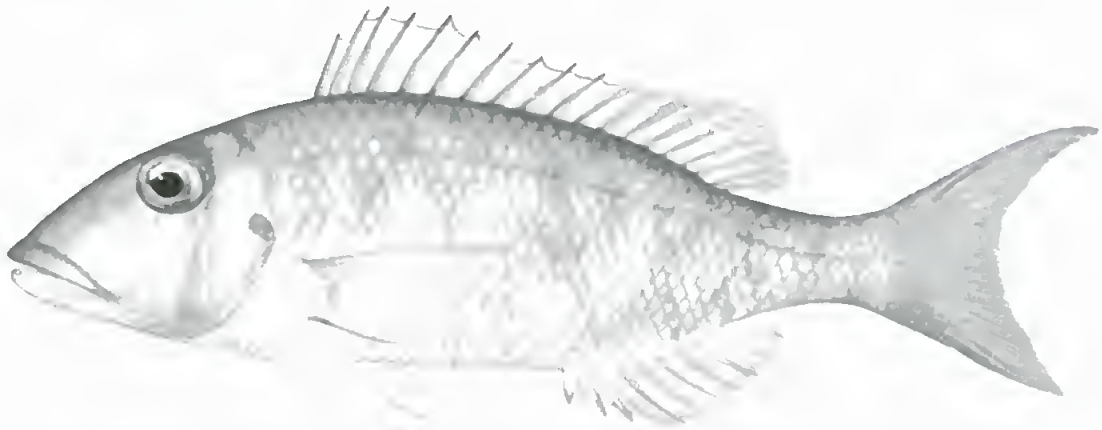


Fig 143

Diagnostic Features: Body moderately elongate, its depth 3.0 to 3.4 times in standard length. Head length 1.1 to 1.2 times in body depth, 2.7 to 3.0 times in standard length, dorsal profile near eye distinctly convex; snout length about 1.8 to 2.1 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile nearly straight or slightly concave, snout angle relative to upper jaw between 55 and 65 degrees; interorbital space flat or slightly convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to or removed from dorsal profile, its length 3.9 to 4.7 times in head length; cheek length 2.4 to 2.9 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine the longest, its length 2.4 to 2.7 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 47 to 49; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 7 to 10 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum with a wide scaleless area. **Colour:** body olive-grey or brown, with scattered irregular small black blotches; lips and a spot on upper edge of operculum usually red; fins pale or pinkish.

Copyright FAO

Geographical Distribution: Widespread in the Indo-West Pacific, including East Africa to southern Japan and the Marquesas (Fig. 144).

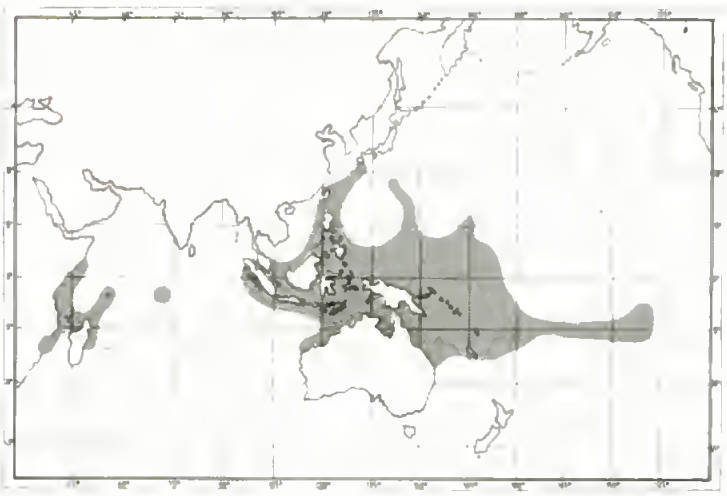


Fig. 144

Habitat and Biology: Inhabits sand and rubble areas of outer reef slopes to depths of 160 m. Feeds mostly on crustaceans, fish echinoderms and molluscs. In New Caledonia there are spawning peaks in December and a fairly high percentage of gonads in advanced stages of maturity occurs between October and February.

Size: Maximum reported total length of 50 cm, commonly to 30 cm total length.

Interest to Fisheries: Caught mostly by handlines, traps and trawls. Marketed mostly fresh. An excellent food fish. One of the most abundant species taken in bottom fisheries in the Marianas.

Local Names: AUSTRALIA: Red-ears; GUAM: Red-gilled emperor, Mafuti; JAPAN: Hōaka-kuchibi; MAURITIUS: Kaya, Cailla, Baxou; NEW CALEDONIA: Bossu varié, Bossu rond; PHILIPPINES: Bitilya, Katambak, Kilawan; SOUTH AFRICA: Spotcheek emperor; Kolwang-keiser; SEYCHELLES: Baxou; TANZANIA: Changu, Changu nyamvi.

Literature: Amesbury & Myers (1982); Burgess & Axelrod (1972, as *L. reticulatus*); Fourmanoir & Laboute (1976, as *Lethrinus variegatus*); Gloerfelt-Tarp & Kailola (1984); Lee (1986); Masuda et al. (1984); Myers (1989); Sainsbury et al. (1985); Smith (1959, as *L. variegatus*); Smith (1986).

Remarks: This is a common and widespread species and it is surprising that it was described and named as late as 1978. It has been assumed by most taxonomists dealing with *Lethrinus* that this species represented the adult form of *L. variegatus*. *Lethrinus variegatus* however, is a small species with distinctive scale counts that are very different from *L. rubrioperculatus*.

The only other possible name for *L. rubrioperculatus* that I have been able to find is *L. jagorii* which was described from the Philippines where *L. rubrioperculatus* is abundant. Sato examined the type and remarked that it was in very bad condition, the only recognizable feature on this 48 mm standard length specimen was that the head is longer than the body depth and that there are 5 scale rows above the lateral line. Peters' (1868) description of the species states that the body depth is 3.5 in standard length and therefore it is most likely one of the slender emperors with conical teeth. The only species of these emperors that has a head length almost equal to body depth in smaller specimens is *L. rubrioperculatus*. This possibility will never be tested however, as the type apparently was destroyed. At my request, N. Downing (formerly of the Kuwait Institute for Scientific Research) who was examining other types in the Zoologisches Museum an der Humboldt Univeristat in Berlin in January, 1989, requested to see the type of *L. jagorii*. He was informed that the records showed that the type was discarded because it had become severly dried out.

Lethrinus semicinctus Valenciennes, 1830

Fig. 145, Plate VII, 42

LETH Leth 18

Lethrinus semicinctus Valenciennes in C. & V., 1830 Hist.nat.poiss., 6: 294 (Bourou).

Synonyms: *Lethrinus sordidus* Valenciennes (1830); *Lethrinus moensii* Bleeker (1855).

FAO Names: En -Black blotch emperor.

Diagnostic Features: Body moderately elongate, its depth 2.9 to 3.1 times in standard length. Head length 1.1 to 1.2 times in body depth, 2.5 to 2.8 times in standard length, the dorsal profile near eye convex; snout length about 1.9 to 2.0 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 55 and 65 degrees; interorbital space flat or slightly

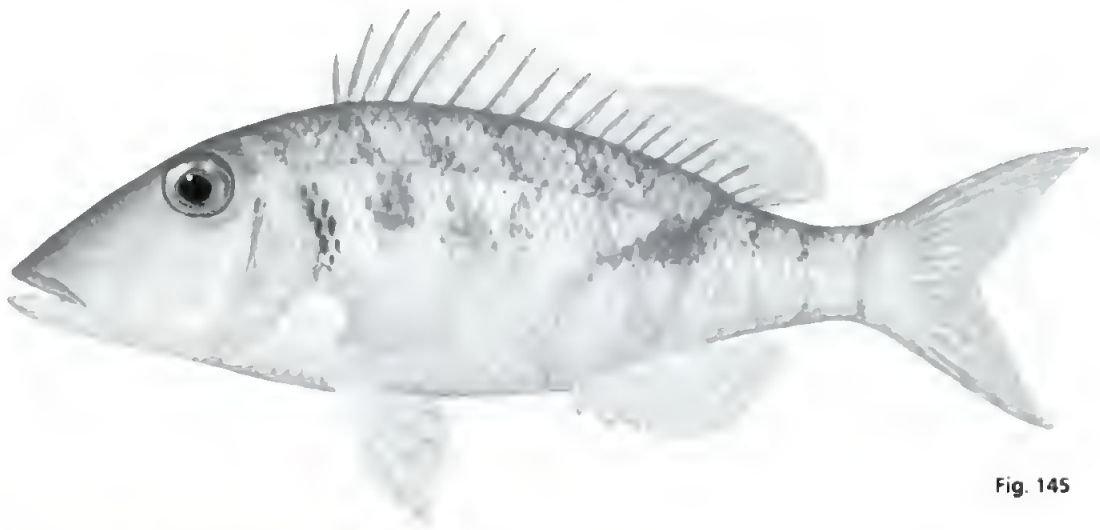


Fig. 145

convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.6 to 4.3 times in head length; cheek length 2.5 to 2.9 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third or fourth dorsal spine the longest, its length 2 3 to 2.7 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length approximately equal to or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 46 to 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 14 or 15 scale rows in transverse series between origin of anal fin and lateral line; 15 rows in lower series of scales around caudal peduncle; 4 to 7 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour**: body brown or tan, with scattered irregular small black blotches, a large oblong black blotch below soft-rayed portion of dorsal fin and bordering below the lateral line; fins pale or pinkish.

Geographical Distribution: Eastern Indian Ocean and Western Pacific, including Sri Lanka, Indonesia, northern Australia, the Ryukyu Islands to the Marshall and Solomon Islands (Fig. 146).

Fig. 146

Habitat and Biology: Inhabits shallow seagrass beds, reef flats, lagoons and sandy areas near coral reefs. Feeds on benthic invertebrates and small fish.

Size: Maximum size to around 35 cm total length.

Interest to Fisheries: Caught by shore seines, trawls, traps and handlines. Marketed fresh. This species is of minor importance to fisheries where it occurs.

Local Names: JAPAN: Ami-fuefuki; PHILIPPINES: Bitilya, Katambak, Kilawan.

Literature: Gloerfelt-Tarp & Kailola (1984); Grant (1982, as *L. variegatus*); Masuda et al. (1984); Sainsbury et al. (1985); Sato in Fischer & Bianchi (eds) (1984).

Remarks: See remarks under *Lethrinus* sp. 2.

Copyright not claimed

Lethrinus sp.1 Fig. 147, Plate VII, 43 **LETH Leth 28**

Possibly undescribed species.

Synonyms: ***Lethrinus*** **sp. Gloerfelt-Tarp & Kailola (1984)**

FAO Names: En - Maldive emperor.

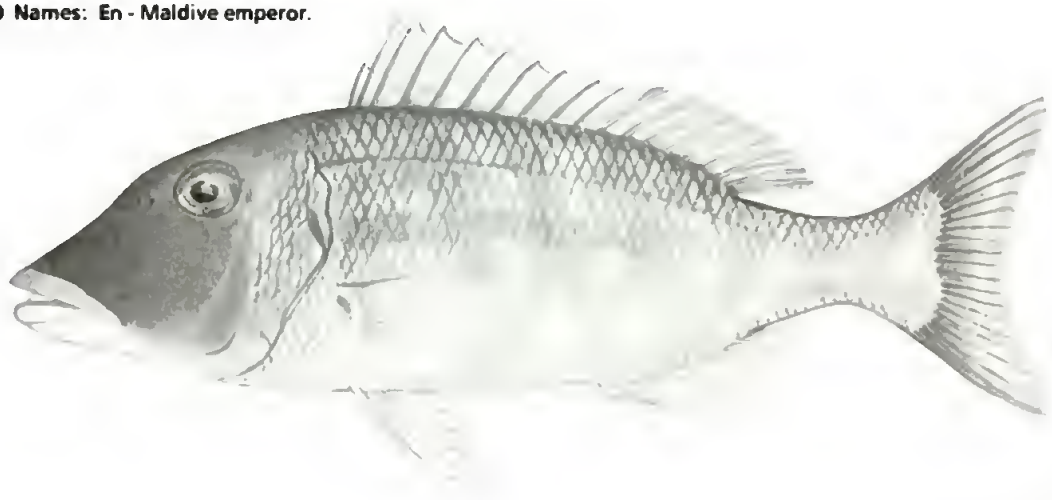


Fig. 147

Diagnostic Features: Body moderately elongate, its depth 3.0 to 3.3 times in standard length. Head length 1.1 to 1.2 times in body depth, 2.6 to 2.8 times in standard length, dorsal profile near eye convex; snout length about 1.8 to 2.0 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile concave with a hump in front of eye, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space flat or convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to or removed from dorsal profile, its length 4.2 to 4.7 times in head length; cheek length 2.4 to 2.7 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine the longest, its length 2.5 to 2.8 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length approximately shorter than the length of the base of the soft-rayed portion of the anal fin and around 0.6 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 47 or 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; usually 15 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 8 to 10 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled.

Colour: body light grey or tan, head darker; base of pectoral fin, spot on upper posterior margin of opercle, posterior edge of preoperculum and indistinct area on snout in front of eye usually reddish; fins pale or reddish.

Geographical Distribution: The Maldives and Southwest Indonesia (Fig 148).

Habitat and Biology: Inhabits sandy areas near coral reefs. Presumably feeds mostly on crustaceans and fish.

Size: Maximum size recorded around 32 cm total length, but presumably attains a much larger size.

Interest to Fisheries: Occasionally caught by hand-lines in the Maldives and by trawls in Indonesia.

Literature: Gloerfelt-Tarp & Kailola (1984, as ***Lethrinus*** sp.).

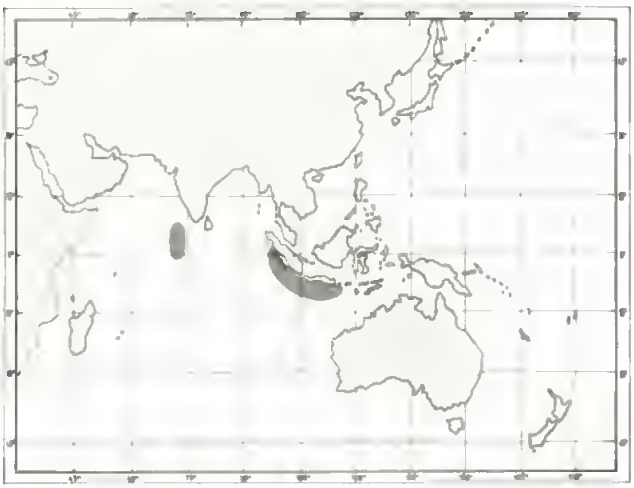


Fig. 148

Remarks: Further work is necessary to confirm that this species does not represent a colour form of ***L. conchyliatus***.

Lethrinus sp.2 Fig 149,Plate VIII, 44 **LETH Leth 29**

Possibly undescribed species

Synonyms: None

FAO Names: En - Drab emperor

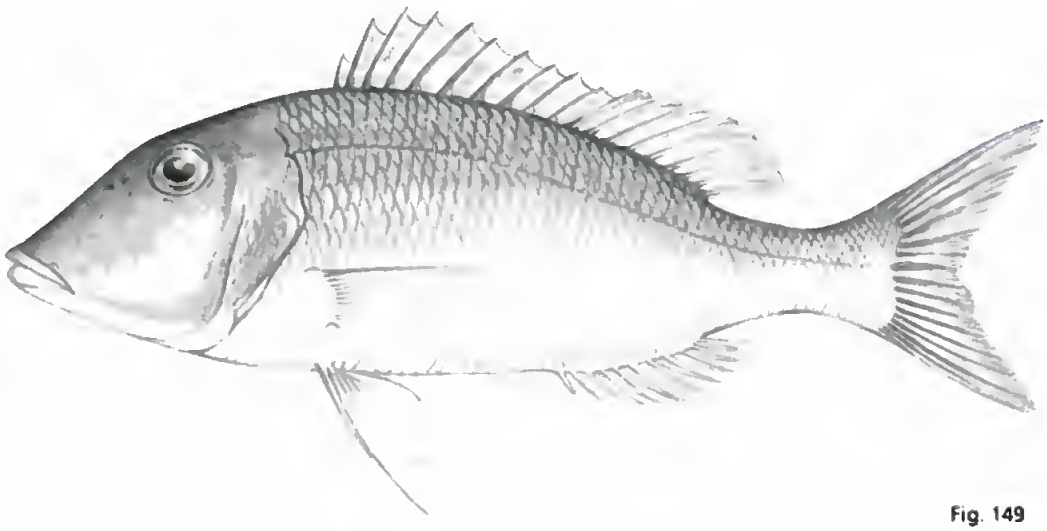


Fig. 149

Diagnostic Features: Body moderately elongate, its depth 2.9 to 3.1 times in standard length. Head length 1.0 to 1.2 times in body depth, 2.7 to 2.9 times in standard length, dorsal profile near eye convex; snout length about 1.9 to 2.0 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 60 and 70 degrees; interorbital space flat or convex; posterior nostril a longitudinal oblong opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.6 to 4.1 times in head length; cheek length 2.4 to 2.9 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth or with a longitudinal ridge. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine the longest, its length 2.4 to 2.6 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 48 or 49; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; usually 15 rows in lower series of scales around caudal peduncle; 6 to 8 scales in supratemporal patch; inner surface of pectoral fin without scales, posterior angle of operculum fully scaled. **Colour**: body light grey or tan with scattered irregular dark blotches; head brown or tan; fins pale.

Copyrighted material

Geographical Distribution: So far known only from the Philippines, the Ryukyu Islands and the Loyalty Islands (Fig. 150)

Habitat and Biology: Nothing is recorded about the biology of this species. All that is known is that in the Philippines it is caught together with smaller specimens of such species as ***Lethrinus olivaceus***, ***L. reticulatus*** and ***L. semicinctus***; it presumably has habitat charactestics similiar to these species.

Size: Maximum recorded total length of around 27 cm, probably attains a slightly larger size.

Interest to Fisheries: Caught by shore seines and trawls.

Local Names: PHILIPPINES: Bitilya, Katambak, Kilawan.

Remarks: Sato's (1978) account of ***L. semicinctus*** includes what he shows as two body types belonging to the same species. ***Lethrinus*** sp 2 will key out to ***L. semicinctus*** using Sato's key. I have collected ***Lethrinus*** sp.2 in Philippines together with ***L. semicinctus*** and the consistent differences in presence of the black blotch, head shape, and number of scales in the supratemporal patch of scales has convinced me that they are distinct species. Further research is necessary to confirm that this species is undescribed.

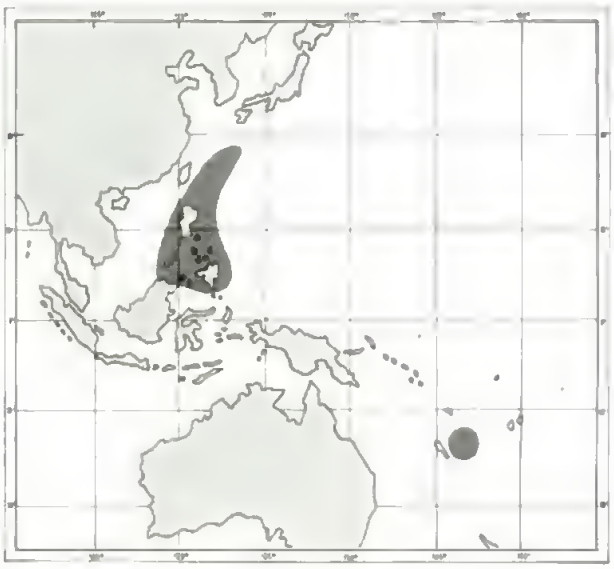


Fig. 150

Lethrinus variegatus Valenciennes, 1830 | Fig. 151, Plate VIII, 45 | **LETH Leth 19**

Lethrinus variegatus Valenciennes in C. & V., 1830 Hist.nat.poiss., 6: 287 (Massuah, Red Sea).

Synonyms: ***Lethrinus latifrons*** Rüppell (1840).

FAO Names: En - Slender emperor.

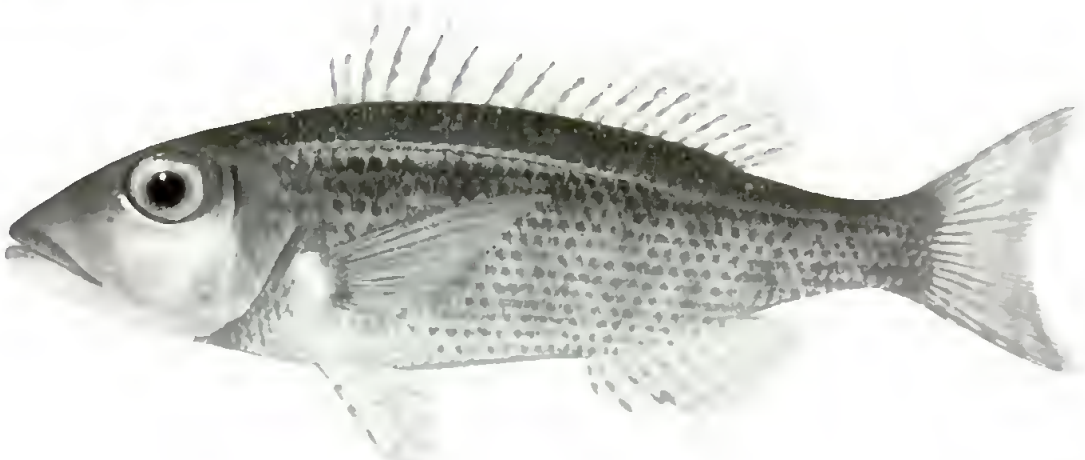


Fig. 151

Diagnostic Features: Body slender, its depth 3.4 to 3.9 times in standard length. Head length 1.2 to 1.4 times in body depth, 2.6 to 2.9 times in standard length, dorsal profile near eye convex; snout length about 2.3 to 2.7 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space flat or convex; posterior nostril a vertical oblong opening, closer to anterior nostril than to orbit, or closer to orbit than anterior nostril; eye situated close to dorsal profile, its length 3.5 to 4.4 times in head length; cheek length 3.0 to 3.8 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the fourth dorsal spine usually the longest, its length 2.0 to 2.5 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its length approximately equal to or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.8 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body without dense melanophores. Lateral-line scales 45 to 47; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 13 or 14 scale rows in transverse series between origin of anal fin and lateral line; 14 or 15 rows in lower series of scales around caudal peduncle; 4 to 7 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled. **Colour:** body brown and grey, lighter ventrally, with scattered irregular dark spots; often two dark bands below eye, one to lower rim of preopercle and one to corner of mouth, another dark band across interorbital space; dorsal, anal, pectoral and pelvic fins light or translucent; caudal fin light and dark striped.

Geographical Distribution: Widespread in the Indo-West Pacific, including the Red Sea, East Africa to the Ryukyu Islands and New Caledonia (Fig. 152).

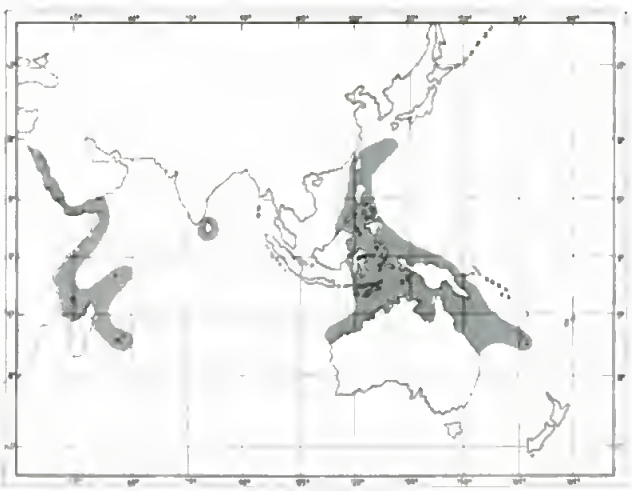


Fig 152

Habitat and Biology: Inhabits sandy and weedy areas near coral reefs. Feeds on small benthic invertebrates.

Size: Maximum total length to around 20 cm.

Interest to Fisheries: Caught mostly by shore seines and trawls. This species is only of minor importance to fisheries where it occurs.

Local Names: JAPAN: Hoso-fuefuki; MAURITIUS: Soudanné; PHILIPPINES: Bitilya, Katambak, Kilawan; SEYCHELLES: Baxou goemon; TANZANIA: Sororo.

Literature: Lee (1986, as *L. semicinctus*); Masuda et al. (1984); Randall (1983); Sato in Fischer & Bianchi (eds) (1984); Schroeder (1980, as *L. reticulatus*).

Remarks: See remarks under *L. rubrioperculatus*.

Lethrinus xanthochilus Klunzinger, 1870

Fig. 153, Plate VIII, 46

LETH Leth 20

Lethrinus xanthochilus Klunzinger, 1870, Verh.Zool.-Bot.Ges.Wein., 20: 753 (Red Sea).

Synonyms: None.

FAO Names: En - Yellowlip emperor.

Diagnostic Features: Body moderately elongate, its depth 2.9 to 3.4 times in standard length. Head length 1.0 to 1.2 times in body depth, 2.6 to 2.9 times in standard length, dorsal profile near eye convex; snout length about 1.8 to 2.3 times in head length, measured without the lip the snout is 0.8 to 0.9 times in cheek height, its dorsal profile nearly straight, snout angle relative to upper jaw between 50 and 60 degrees; interorbital space concave; posterior nostril a longitudinal or vertical oblong opening, closer to orbit than to anterior nostril; eye situated close to dorsal profile, its length 3.4 to 5.1 times in head length; cheek length 2.3 to 3.3 times in head length; lateral teeth in jaws conical; outer surface of maxilla smooth. Dorsal fin with 10 spines and 9 soft rays, the third dorsal spine usually the longest, its length 2.2 to 2.8 times in body depth; anal fin with 3 spines and 8 soft rays, the first soft ray usually the longest, its

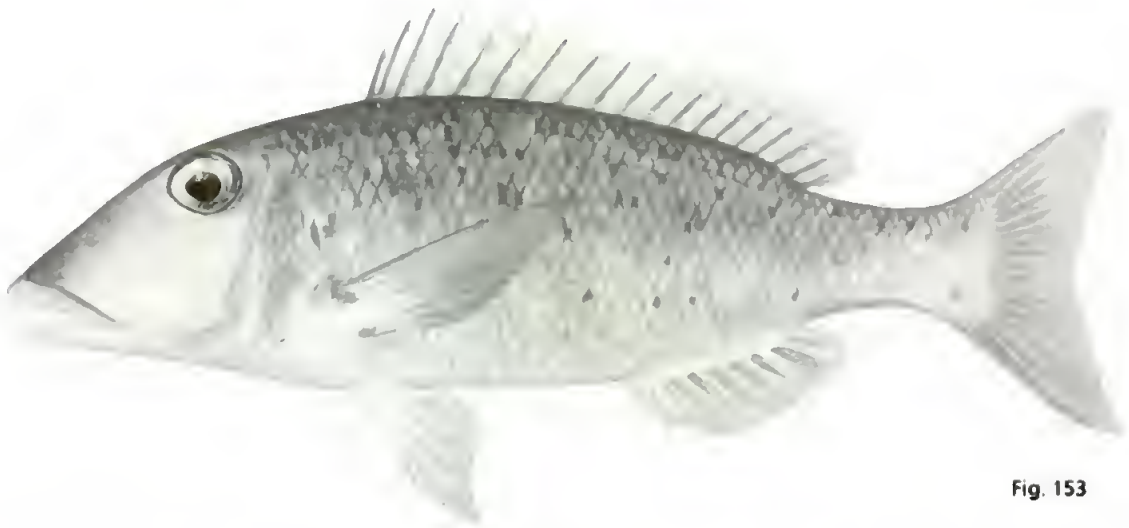


Fig. 153

length approximately equal to or shorter than the length of the base of the soft-rayed portion of the anal fin and 0.6 to 0.7 times in the length of the entire anal fin base; pectoral rays 13; pelvic fin membranes between the rays closest to the body with dense melanophores. Lateral-line scales 47 or 48; cheek without scales; 4 1/2 scale rows between lateral line and base of middle dorsal fin spines; 15 or 16 scale rows in transverse series between origin of anal fin and lateral line; 15 rows in lower series of scales around caudal peduncle; 5 to 8 scales in supratemporal patch; inner surface of pectoral fin without scales; posterior angle of operculum fully scaled or rarely with a naked patch. **Colour:** body yellowish grey with scattered irregular dark spots; lips yellowish, the upper lip more intense; a red spot at upper base of pectoral fin; fins bluish grey and mottled, the bases of fins lighter and the edges of the dorsal and caudal fins reddish.

Geographical Distribution: Widespread in the Indo-West Pacific, including the Red Sea, East Africa, Central Indian Ocean, Indonesia to the Ryukyu Islands, the Caroline Islands to the Marquesas, New Caledonia and Vanuatu (Fig. 154).

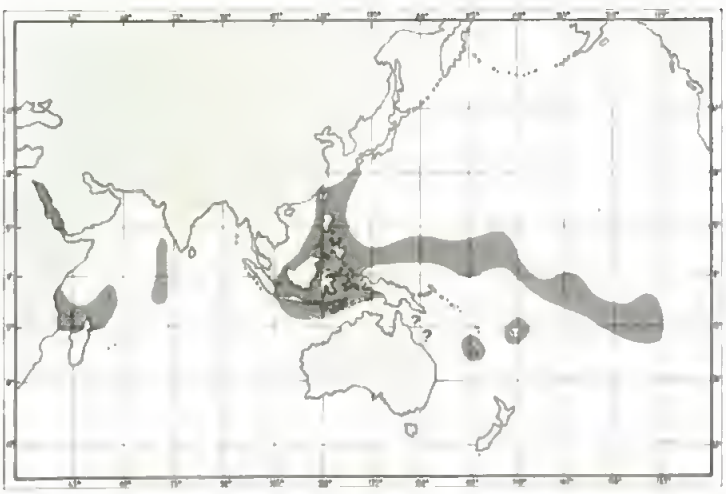


Fig. 154

Habitat and Biology: Inhabits seagrass beds and, sand and rubble areas of coral reefs, deep channels, and lagoons. Often found in shallow water but recorded to depths of 150 m. Occurs usually in small groups. Feeds primarily on crustacea, fishes, and echinoderms.

Estimates of asymptotic length ($L_{infinity}$) and coefficient of growth (K) have been made for a population in Papua New Guinea: $L_{infinity}$ = 55.0 cm fork length, and K = 0.30.

Size: Maximum size to around 60 cm total length.

Interest to Fisheries: Caught mostly with handlines, traps and trawls.

Local Names: JAPAN: Muneaka-kuchibi; LACCADIVES: Kilukkam-metti, Rythung-filolu; KENYA: Kibora; MAURITIUS: Barrois; PHILIPPINES: Bitilya, Katambak, Kilawan; POLYNESIA: Oeo utupoto, Oeo tiamu, Ninuki, Vipuake, Manukena; SAUDI ARABIA: Shaoor, Sheiry; SOUTH AFRICA: Yellowlip emperor, Geelip-keiser; TANZANIA: Changu m'domo, Changu n'yavi, Changu n'doba.

Literature: Allen & Steene (1987, as *L. variegatus*); Bagnis et al. (1972); Masuda et al. (1984); Randall (1983); Sato in Fischer & Bianchi (eds) (1984).

Monotaxis Bennett, 1830

LETH Mono

Genus: ***Monotaxis*** Bennett, 1830. 688 Type-species ***Monotaxis indica*** Bennett, 1830 (= ***Monotaxis grandoculis*** [Forsskål, 1775]), by monotypy

Synonyms: ***Sphaerodon*** Ruppell, 1840

A single species in the genus - see ***Monotaxis grandoculis***

Monotaxis grandoculis (Forsskål, 1775)

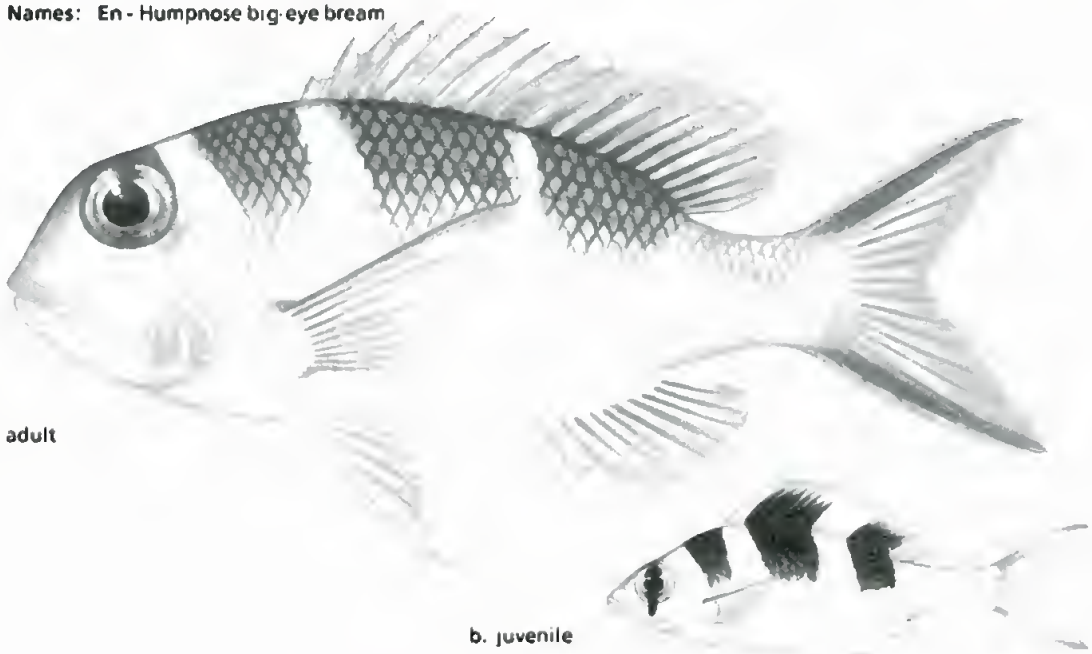
Fig 155, Plate VIII, 47-49

LETH Mono 1

Sciaena grandoculis Forsskål, 1775, Descrip Animal : xi, 53 (Arabia)

Synonyms: ***Monotaxis indica*** Bennett (1830); ***Lethrinus latidens*** Valenciennes (1830); ***Pagrus heterodon*** Bleeker (1854b).

FAO Names: En - Humpnose big-eye bream

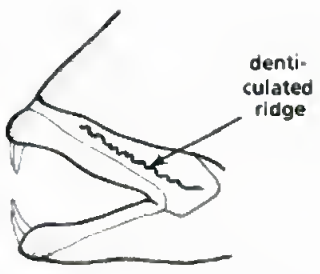


a. adult

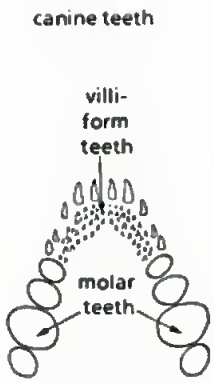
b. juvenile

Fig 155

Diagnostic Features: Body oblong, its depth 2.1 to 2.7 times in standard length. Head profile strongly convex in front of eye, the snout sloping steeply; eye large, its diameter about equal to length of snout or 2.5 to 3.2 times in head length; interorbital space wide and flat; hind margin of preopercle finely serrated; posteriormost part of jaws reaching beyond vertical through anterior margin of eye; a broad patch of small teeth in jaws anteriorly, followed by a series of 6 or 7 round, flat molars on each side and preceded by canines in front of each jaw; maxilla with a longitudinal denticulated ridge. Dorsal fin with 10 slender spines and 10 soft rays, the first spine half the length of second otherwise remaining spines about equal; anal fin with 3 spines and 9 soft rays; pectoral rays 14 including splint-like uppermost ray; caudal fin forked with pointed tips. Lateral-line scales 44 to 47, about 4 or 5 horizontal scale rows above lateral line; inner surface of pectoral fin base densely scaled.



lateral view of mouth (lateral teeth not shown) Fig 156



roof of mouth Fig 157

Colour: ground colour generally bluish-grey grading to whitish on ventral parts; lips yellow to pinkish; area around eye often yellow or orange; fins generally without distinctive markings, the membranes clear or dusky, but often reddish to yellow-orange; base of upper pectoral fin rays and inner base (i.e. body side) of pectoral axil black; caudal fin frequently with blackish rays contrasted against paler membranous part of fin. Small juveniles whitish on lower half and with 3 prominent black saddles separated by narrower white bars on upper half; a prominent black bar through eye; fins clear to white except the dorsal fin which includes the continuation of 2 of the black saddles of the upper side and the outer edges of the caudal fin lobes which are yellow-brown. The juvenile pattern of bars is often seen in relatively large (20 to 30 cm) individuals. Even the largest adults, although usually seen without markings, are able to rapidly assume dark bars or saddles on the body.

Geographical Distribution: Widespread in the Indo-West and Central Pacific from the Hawaiian Islands and southeastern Oceania to the east coast of Africa and Red Sea and from Australia northwards to Japan (Fig. 158).

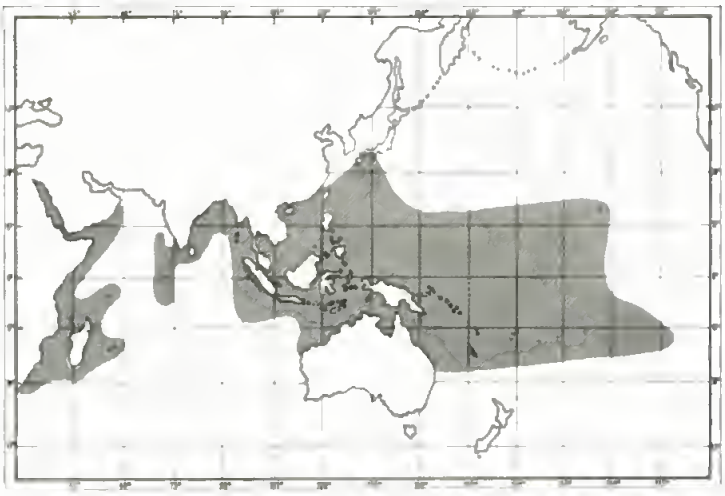


Fig. 158

Habitat and Biology: Generally found in the vicinity of coral reefs, often on the sandy periphery of individual reef complexes or in sand and rubble areas. Solitary fish are often encountered, but large adults frequently form aggregations of up to about 50 individuals. Two distinct colour forms are seen which has lead to speculation that 2 species may be involved: a dark variety with broad black saddles on the back separated by narrow white interspaces and a paler variety having the saddles more widely separated.

Observations on the Great Barrier Reef indicated that dark-phase individuals are usually associated with the higher-contrast environment of the coral reef whereas the light-phase fish are generally seen over sand or light-coloured rubble. Moreover, the lighter fish were seen to quickly assume the dark pattern when harrassed with a spear gun. The depth range is between about 3 and 60 m, although it appears to be most common between about 5 and 30 m. The diet consists mainly of gastropod molluscs, ophiuroids, and echinoids. Items of lesser importance include pagurid and brachyuran crabs, polychaetes, tunicates, and holothurians.

Size: Maximum total length about 60 cm; common to 40 cm.

Interest to Fisheries: Frequently found in markets. Caught mainly with gillnets, traps, spears, and handlines. Average quality flesh that is marketed mostly fresh. In the Marshall Islands, this species was found sometimes to be ciguatoxic.

Local Names: AUSTRALIA: Humpnose bigeye-bream; INDONESIA: Levovangan (Simalur); JAPAN: Yokoshima-kurodai; LACCADIVE ISLANDS: Dathi, Pallan; MALAYSIA: Ikan gigi oran; NEW CALEDONIA: Brème aux gros yeux; PAKISTAN: Tailgi; PAPUA NEW GUINEA: Budia (Port Moresby); PHILIPPINES: Dapak, Gapas-gapas, Malaking-mata; SOUTH AFRICA: Bigeye barenose; SRI LANKA: Angana; TAHITI: Mu; USA: Hawaii: Mu, Mamamu.

Literature: Sato in Fischer & Bianchi (eds.) (1984); Sato (1986); Allen & Swainston (1988)

Wattsia **Chan & Chilvers, 1974** — Fig. 159, Plate VIII, 50 — **LETH Watt**

Genus: ***Wattsia*** Chan & Chilvers, 1974:85. Type-species ***Gnathodentex mossambicus*** Smith, 1957, by original designation.

Synonyms: None

A single species in the genus - see ***Wattsia mossambica***

Copyrighted material

Wattsia mossambica (Smith, 1957) Fig. 159, Plate VIII, 50 **LETH Watt 1**

Gnathodentex mossambicus Smith, 1957, Ann. Mag. Nat. Hist., Ser. XII,10 (110): 121-124 (Mozambique).

Synonyms: None

FAO Names: En - Mozambique large-eye bream

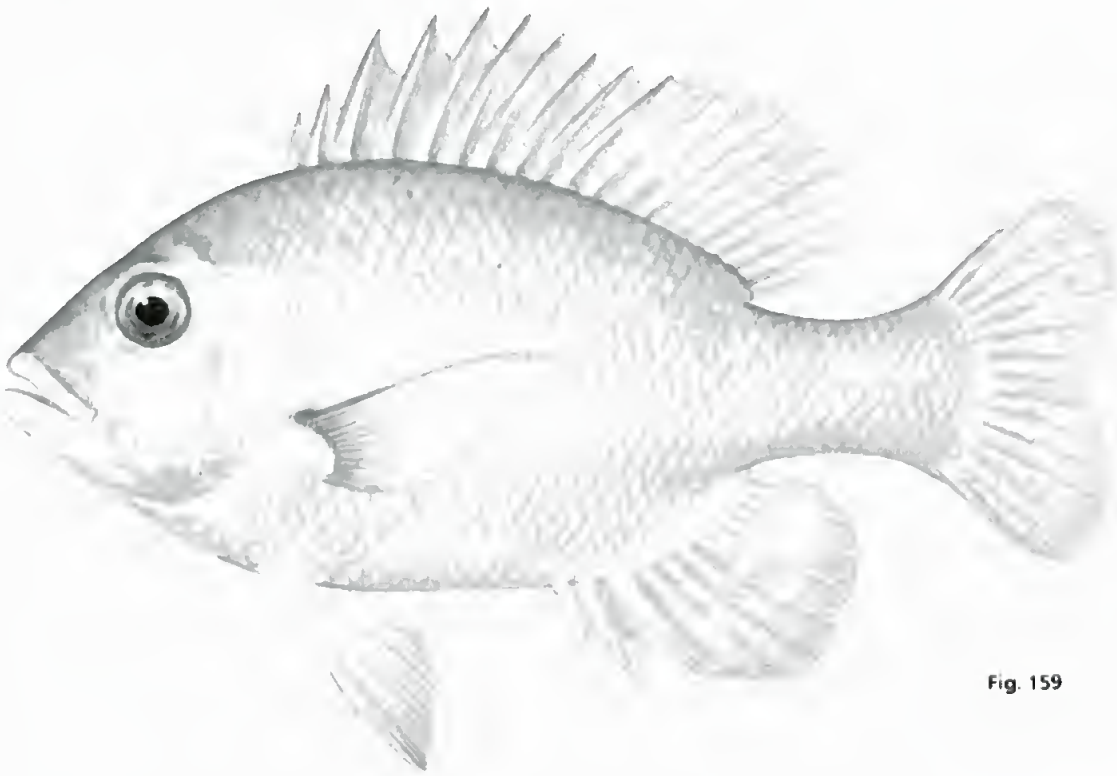
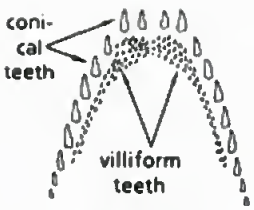


Fig. 159

Diagnostic Features: Body relatively deep, roughly rhomboid, its depth 1.9 to 2.2 times in standard length. Head profile slightly convex; eye moderate in size, its diameter much shorter than snout length; jaw teeth in a narrow, villiform band bordered by an outer series of conical teeth; anteriorly 4 moderate-sized canines in upper jaw and 6 in lower jaw; maxilla with a longitudinal denticulated ridge; a pair of close-set nasal openings, the posterior one slit-like, ending close to eye. Dorsal fin with 10 long, strong spines and 10 soft rays; first spine about 2/3 the length of the second, the second spine slightly longer than eye diameter, the fourth to sixth spines longest; anal fin with 3 strong spines and 10 soft rays; third spine twice as long as eye diameter; anal fin base 1.4 to 1.6 times longer than longest anal fin ray; caudal fin slightly forked with broadly rounded lobes. Lateral-line scales 41 to 47; 5 scale rows between lateral line and base of middle dorsal fin spines; inner surface of pectoral fin axil scaleless. **Colour:** overall silvery-grey with yellowish suffusion; scale margins narrowly brownish; indistinct dark blotches or bars sometimes apparent on body; lips whitish to yellow; fins yellow, faint brown spotting may be present on soft dorsal, anal, and caudal; a narrow blackish bar across base of pectoral fin.



roof of mouth
Fig. 160

Fig. 161

Geographical Distribution: Tropical Indian Ocean and western Pacific. It is known only from a few scattered localities including Mozambique, Malay Peninsula, New Guinea, southern China, and Japan (Fig. 162).

Habitat and Biology: Inhabits the outer edge of the continental shelf at depths between 100 and 180 m. It feeds on bottom-living invertebrates and small fishes.

Size: Maximum total length about 55 cm; common to 35 cm.

Interest to Fisheries: Occasionally seen in markets, mainly fresh. Caught mainly with bottom longlines and bottom trawls.

Local Names: JAPAN: Koke-nokogiri.

Literature: Sato in Fischer & Bianchi (eds.) (1984), Masuda et al. (1984); Smith & Heemstra (eds.) (1986); Sato (1986).

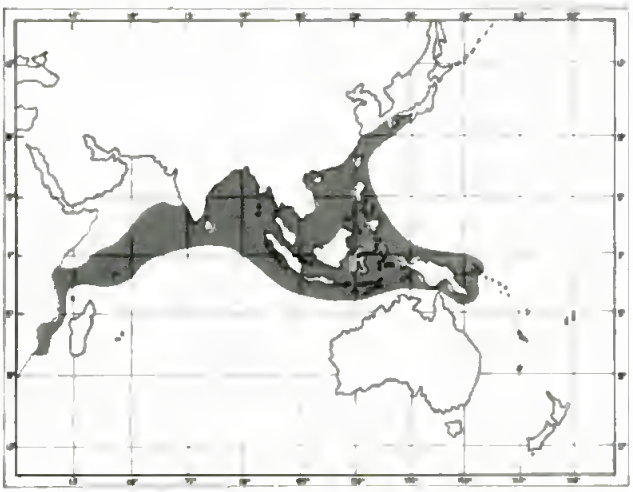


Fig. 162

3. LIST OF NOMINAL SPECIES OF LETHRINIDAE

The following list gives in order (i) the scientific name as it originally appeared in alphabetical order according to the specific name; (ii) the author(s) - Valenciennes = in Cuvier & Valenciennes; Schlegel = in Temminck & Schlegel; Gil. & Thomp = Gilchrist & Thompson; (iii) date of publication; and (iv) present identification.

(a) Genera *Gnathodentex*, *Gymnocranius*, *Monotaxis* and *Wattsia* (provisional list by G R. Allen)

Monotaxis affinis Whitely, 1943	*Gymnocranius euanus*
Gymnocranius audleyi Ogilby, 1916	*Gymnocranius audleyi*
Sparus aureolineatus Lacepède, 1802	*Gnathodentex aurolineatus*
Gymnocranius bitorquatus Cockerell, 1916	*Gymnocranius audleyi*
Pentapus curtus Guichenot, 1865	*Gymnocranius grandoculis*
Pentapus dux Valenciennes 1862	*Gymnocranius grandoculis*
Gymnocranius elongatus Senta, 1973	*Gymnocranius elongatus*
Sphaerodon euanus Gunther, 1879	*Gymnocranius euanus*
Gymnocranius frenatus Bleeker, 1873	*Gymnocranius frenatus*
Sciaena grandoculis Forsskål, 1775	*Monotaxis grandoculis*
Cantharus grandoculis Valenciennes 1830	*Gymnocranius grandoculis*
Dentex griseus Schlegel, 1844	*Gymnocranius griseus*
Pagrus heterodon Bleeker, 1854b	*Monotaxis grandoculis*
Monotaxis indica Bennett, 1830	*Monotaxis grandoculis*
Gymnocranius japonicus Akazaki, 1961	*Gymnocranius euanus*
Lethrinus latidens Valenciennes 1830	*Monotaxis grandoculis*
Dentex lethrinoides Bleeker, 1851a	*Gymnocranius grandoculis*
Dentex lycogenis Bennett, 1831	*Gnathodentex aurolineatus*
Paradentex marshalli Whitley, 1936	*Gymnocranius grandoculis*
Dentex microdon Bleeker, 1851c	*Gymnocranius microdon*
Lobotes microprion Bleeker, 1851b	*Gymnocranius griseus*
Gnathodentex mossambicus Smith, 1957	*Wattsia mossambica*
Gnathodentex ocumaculatus Herre, 1935	*Gnathodentex aurolineatus*
Gymnocranius olivaceus Formanoir, 1961	*Wattsia mossambica*
Gymnocranius orbis Fowler, 1938	*Gymnocranius griseus*
Dentex rivulatus Ruppell, 1838	*Gymnocranius grandoculis*
Dentex robinsoni Gil. & Thomp , 1908	*Gymnocranius grandoculis*
Gymnocranius ruppellii Smith, 1941	*Gymnocranius grandoculis*
Dentex xanthopterus Bleeker, 1845	nomen nudum

(b) Genus *Lethrinus* by K. E. Carpenter

Lethrinus abbreviatus Valenciennes, 1830	*Lethrinus mahsena*
Lethrinus acutus Klunzinger, 1884	*Lethrinus microdon*
Lethrinus alboguttatus Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus amamianus Akazaki, 1962	*Lethrinus miniatus*
Lethrinus amboinensis Bleeker, 1854d	*Lethrinus amboinensis*
Lethrinus anarhynchus Postel, 1965	*Lethrinus laticaudis*
Lethrinus anatarius Richardson, 1844	*Lethrinus nebulosus*
Lethrinus argenteus Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus atkinsoni Seale, 1909	*Lethrinus atkinsoni*
Lethrinus atlanticus Valenciennes, 1830	*Lethrinus atlanticus*
Lethrinus aurolineatus Fourmanoir, 1961	junior homonym
Lethrinus aurolineatus Macleay, 1883	*Lethrinus nebulosus*
Lethrinus azureus Valenciennes, 1830	*Lethrinus harak*

Copyright reserved

Lethrinus bleekeri Klunzinger, 1884	*Lethrinus harak*
Lethrinus bonhamensis Gunther, 1873	*Lethrinus harak*
Lethrinus borbonicus Valenciennes, 1830	*Lethrinus borbonicus*
Lethrinus bungus Valenciennes, 1830	*Lethrinus borbonicus*
Lethrinus caeruleus Valenciennes, 1830	*Lethrinus mahsena*
Lethrinus carinatus Weber, 1913	*Lethrinus nebulosus*
Lethrinus centurio Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus choerorynchus Bloch & Schneider, 1801	*Lethrinus nebulosus*
Lethrinus chrysostomus Richardson, 1848	*Lethrinus miniatus*
Lethrinus cinereus Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus cinnabarinus Richardson, 1843	*Lethrinus erythracanthus*
Lethrinus cocosensis Bleeker, 1854a	*Lethrinus lentjan*
Lethrinella conchyliatus Smith, 1959	*Lethrinus conchyliatus*
Lethrinus croceopterus Valenciennes 1830	*Lethrinus lentjan*
Lethrinus crocineus Smith, 1959	*Lethrinus crocineus*
Lethrinus cutambi Seale, 1909	*Lethrinus obsoletus*
Lethrinus cyanoxanthus Richardson, 1843	*Lethrinus nebulosus*
Lethrinus devisianus Whitley, 1929	*Lethrinus nebulosus*
Lethrinus ehrenbergii Valenciennes, 1830	*Lethrinus borbonicus* ?
Lethrinus elongatus Valenciennes, 1830	*Lethrinus microdon*
Lethrinus enigmaticus Smith, 1959	*Lethrinus enigmaticus*
Lethrinus erythracanthus Valenciennes, 1830	*Lethrinus erythracanthus*
Lethrinus erythrophthalmus Kittlitz, 1858	nomen nudum
Lethrinus erythropterus Valenciennes, 1830	*Lethrinus erythropterus*
Lethrinus erythrurus Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus esculentus Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus fasciatus Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus flavescens Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus fletus Whitley, 1943	*Lethrinus laticaudis*
Lethrinus floridus Wheeler, 1961	*Lethrinus conchyliatus*
Lethrinus fraenatus Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus fusciceps Macleay, 1878	*Lethrinus lentjan*
Lethrinus geniguttatus Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus genivittatus Valenciennes, 1830	*Lethrinus genivittatus*
Lethrinus glyphodon Gunther, 1859	*Lethrinus lentjan*
Lethrinus gothofredi Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus guentheri Bleeker, 1873	*Lethrinus nebulosus*
Lethrinus haematopterus Temminck & Schlegel 1842	*Lethrinus haematopterus*
Sciaena harak Forsskål, 1775	*Lethrinus harak*
Lethrinus hypselopterus Bleeker, 1873	*Lethrinus erythropterus*
Lethrinus imperialis DeVis, 1884a	*Lethrinus miniatus*
Lethrinus insulindicus Bleeker, 1873	*Lethrinus ornatus*
Lethrinus jagorii Peters, 1868	nomen dubium
Lethrinus johnii Castelnau, 1873	*Lethrinus harak*
Lethrinus kallopterus Bleeker, 1856	*Lethrinus erythracanthus*
Lethrinus karwa Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus korely Valenciennes, 1830	*Lethrinus nebulosus*
Lethrinus lachrymans Saville-Kent, 1893	nomen nudum
Lethrinus laticaudis Alleyene & Macleay, 1877	*Lethrinus laticaudis*
Lethrinus latifrons Rüppell, 1840	*Lethrinus variegatus*
Bodianus lentjan Lacepède, 1802	*Lethrinus lentjan*
Lethrinus longirostris Playfair & Gunther, 1866	*Lethrinus olivaceus*
Lethrinus maculatus Valenciennes, 1830	*Lethrinus nebulosus*
Sciaena mahsena Forsskål, 1775	*Lethrinus mahsena*
Lethrinus mahsenoides Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus margaritifer Saville-Kent, 1893	nomen nudum
Lethrinus microdon Valenciennes, 1830	*Lethrinus microdon*
Lethrinus miniatus Schneider, 1801	*Lethrinus miniatus*
Lethrinus moensii Bleeker, 1855	*Lethrinus semicinctus*
Sciaena nebulosa Forsskål, 1775	*Lethrinus nebulosus*
Lethrinus nematacanthus Bleeker, 1854c	*Lethrinus genivittatus*

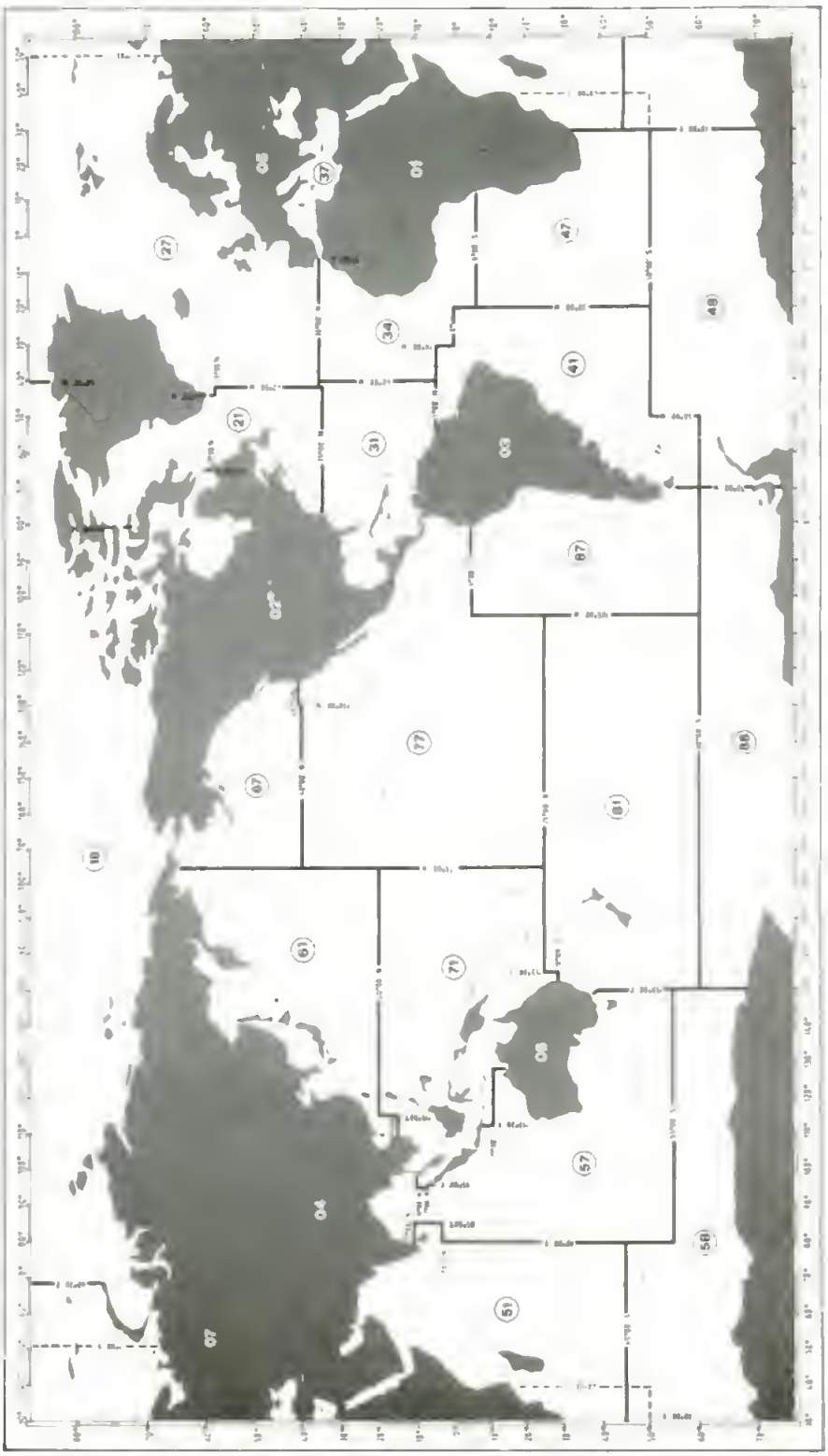
Pentapodus nubilis Cantor, 1849	*Lethrinus lentjan*
Sciaena obsoleta Forsskål, 1775	*Lethrinus obsoletus*
Lethrinus olivaceus Valenciennes, 1830	*Lethrinus olivaceus*
Lethrinus opercularis Valenciennes, 1830	*Lethrinus lentjan*
Lethrinus ornatus De Vis 1884b	Junior homonym
Lethrinus ornatus Valenciennes, 1830	*Lethrinus ornatus*
Lethrinus papuensis Alleyne & Macleay, 1877	*Lethrinus harak*
Lethrinus perselectus Whitley, 1933	*Lethrinus nebulosus*
Lethrinus punctulatus Macleay, 1878	*Lethrinus lentjan*
Sciaena ramak Forsskål, 1775	*Lethrinus obsoletus*
Lethrinus regius Saville-Kent, 1893	nomen nudum
Lethrinus reticulatus Valenciennes, 1830	*Lethrinus reticulatus*
Lethrinus rhodopterus Bleeker, 1852	*Lethrinus harak*
Lethrinus richardsoni Gunther, 1859	*Lethrinus haematopterus*
Lethrinus rostratus Valenciennes, 1830	*Lethrinus olivaceus*
Lethrinus rostratus specificus Borodin, 1932	*Lethrinus olivaceus*
Lethrinus rubrioperculatus Sato, 1978	*Lethrinus rubrioperculatus*
Lethrinus sanguineus Smith, 1955	*Lethrinus mahsena*
Lethrinus scoparius Gilchrist & Thompson, 1908	*Lethrinus nebulosus*
Lethrinus semicinctus Valenciennes, 1830	*Lethrinus semicinctus*
Lethrinus sordidus Valenciennes, 1830	*Lethrinus semicinctus*
Lethrinus striatus Steindachner, 1866	*Lethrinus erythropterus*
Lethrinus undulosus Monroe, 1955	nomen nudum
Lethrinus variegatus Valenciennes, 1830	*Lethrinus variegatus*
Lethrinus virescens Valenciennes, 1830	*Lethrinus lentjan*?
Lethrinus viridis Saville-Kent, 1893	nomen nudum
Lethrinus waigiensis Valenciennes, 1830	*Lethrinus olivaceus*
Lethrinus xanthochilus Klunzinger, 1870	*Lethrinus xanthochilus*
Lethrinus xanthopterus Valenciennes, 1830	*Lethrinus olivaceus*?
Lethrinus xanthotaenia Bleeker, 1851b	*Lethrinus ornatus*

4. LIST OF SPECIES BY MAJOR MARINE FISHING AREAS

	PAGE	GEOGRAPHICAL DISTRIBUTION						
		MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES						
		34	51	57	61	71	77	81
Gnathodentex aurolineatus			●	●	●	●	●	●
Gymnocranius audleyi					●			
Gymnocranius elongatus			●	●	●	●		
Gymnocranius euanus					●	●		
Gymnocranius frenatus					●	●		
Gymnocranius grandoculis			●	●	●	●	●	●
Gymnocranius griseus			?	●	●	●		
Gymnocranius microdon				●	●	●		
Gymnocranius sp					●	●		?
Lethrinus amboinensis				●	●	●	●	
Lethrinus atkinsoni				●	●	●	●	
Lethrinus atlanticus		●						
Lethrinus borbonicus			●					
Lethrinus conchyliatus			●	●				
Lethrinus crocineus			●					
Lethrinus enigmaticus			●					
Lethrinus erythracanthus			●	●	●	●	●	
Lethrinus erythropterus			●	●		●		
Lethrinus genivittatus				●	●	●		
Lethrinus haematopterus					●			

	PAGE	GEOGRAPHICAL DISTRIBUTION						
		MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES						
		34	51	57	61	71	77	81
Lethrinus harak			●	●	●	●	●	
Lethrinus laticaudis				●		●		
Lethrinus lentjan			●	●	●	●	●	
Lethrinus mahsena			●					
Lethrinus microdon			●	●	●	●		
Lethrinus miniatus				●	●	●		
Lethrinus nebulosus			●	●	●	●	●	●
Lethrinus obsoletus			●	●	●	●	●	
Lethrinus olivaceus			●	●	●	●	●	
Lethrinus ornatus			●	●	●	●		
Lethrinus reticulatus			●	●	●	●		
Lethrinus rubrioperculatus			●	●	●	●	●	
Lethrinus semicinctus			●	●	●	●		
Lethrinus sp. 1			●	●				
Lethrinus sp. 2					●	●		
Lethrinus variegatus			●	●	●	●		
Lethrinus xanthochilus			●	●	●	●	●	
Monotaxis grandoculis			●	●	●	●	●	●
Wattsia mossambica			●	●	●	●		

MAJOR MARINE FISHING AREAS FOR STATISTICAL PURPOSES



5. BIBLIOGRAPHY

Akazaki, M., 1958. Studies on the orbital bones of sparoid fishes. Zool Mag., Tokyo, 67:322-25

----------, 1959. Comparative morphology of pentapodid fishes. Zool Mag., Tokyo, 68(10):373-77

----------, 1961. Results of the Amami Islands expedition no. 4 on a new sparoid fish, *Gymnocranius japonicus* with special reference to its taxonomic status. Copeia, 1961 (4):437-41

----------, 1962. Studies on the spariform fishes. Anatomy, phylogeny, ecology and taxonomy. Misaki Mar.Biol.Inst.,Kyoto Univ., Spec. Rep., No. 1, 368 p.

Aldonov, KV.& A.D. Druzhinin, 1979. Some data on scavenger (family Lethrinidae) from the Gulf of Aden region. Voprosy Ikhthiologii, 18(4):527-35

Allen, G.R. & R.C. Steene, 1979. The fishes of Christmas Island, Indian Ocean. Aust.nat.Parks Wildl.Serv.Spec.Publ., 2:1-81

----------, 1987. Reef fishes of the Indian Ocean. T.F.H. Publications, Neptune City, 240 p., 144 pls

----------, 1988. Fishes of Christmas Island, Indian Ocean. Christmas Island Natural History Association, 199 p.

Allen, G. R. & R. Swainston, 1988. The Marine fishes of North-western Australia. A field guide for anglers and divers. Western Australian Museum, Perth, 201 p.

Alleyne, H.G. & W. Macleay, 1877. The ichthyology of the Chevert expedition. Proc. Linn.Soc. New South Wales, 1:261-80, pls 3-9

Amesbury, S. S. & R. F. Myers, 1982. Guide to the coastal resources of Guam, Volume I. The Fishes. University of Guam Press, 141 p.

Asano, H., 1978. On the tendencies of differentiation in the composition of the vertebral number of teleostean fishes. Mem.Fac.Agric.Kinki Univ., 10(1977):29-37

Baddar, M.K., 1987. A preliminary study of the population dynamics of a Sheiry, the Starry pigface bream, *Lethrinus nebulosus*. Kuwait Bull.Mar.Sci., 1987(9):215-20

Bagnis, R. et al., 1972. Fishes of Polynesia. Les éditions du Pacifique, Papeete. 368 p.

Bauchot, M.L., M. Desoutter & T. Sato, 1983. Catalogue critique des types de Poissons du Muséum national d'Histoire naturelle. Bull. Mus. natn. Hist. nat., Paris. (4)5A(2): 63-78

Bennett, E. T, 1830. Memoir of the life and public services of Sir Stamford Raffles. Fishes. London, 694 p.

----------, 1831. Observations on a collection of fishes from the Mauritius with characters of new genera and species. Proc. Zool. Soc. London. 1:32,59-61,126-28,165-69

----------, 1835. Characters of several previously undescribed fishes from Trebizond. Proc. Zool. Soc. London, (3):91-92

Bertrand, J., 1986. Données concernant la reproduction de *Lethrinus mahsena* (Forsskål, 1775) sur les bancs de Saya de Malha (Océan Indien). Cybium, 10(1):15-29

----------, 1988. Selectivity of hooks in the handline fishery of the Saya de Malha banks, Indian Ocean. Fish.Res.(Amst.)., 6(3):249-56

Bianchi, G., 1985a. FAO Species identification sheets for fishery purposes. Field guide to the commercial marine and brackish-water species of Tanzania. FAO, Rome, 199 p.

----------, 1985b. FAO Species identification sheets for fishery purposes. Field guide to the commercial marine and brackish-water species of Pakistan. FAO, Rome, 200 p.

Bleeker, P., 1845. Bijdragen tot de geneeskundige topographie van Batavia. Generisch overzicht der fauna (Continuatio). Nat. Geneesk. Arch. Ned. Ind., 2:497-542

----------, 1850. Bijdrage tot de kennis der sparoiden van den Soenda-Molkschen archipel. Verh. Bat. Gen., 23(Spar.):1-16

Bleeker, P., 1851a. Faunae ichthyologicae Javae insularumque adjacentium. Genera et species novae. Nat. Tijdschr. Ned.-Indië, 1:98-108

----------, 1851b. Nieuwe Bijdrage tot de kennis der Percoidei, Scleroparei, Sciaenoidei, Sparoidei, Maenoidei, Chaetodontoidei en Scomberoidei van den Soinda-Molukschen archipel. Nat. Tijdschr. Ned.-Indië, 2:163-79

----------, 1851c. Nieuwe bijdrage tot de kennis der ichthyologische fauna van Celebes. Nat. Tijdschr. Ned.-Indie,. 2:209-24

----------, 1852. Bijdrage tot de kennis der ichthyologische fauna van Singapore. Nat. Tijdschr.Ned.-Indië, 3:51-86

----------, 1853. Diagnostische beschrijvingen van nieuwe of weinig bekende vischsoorten van Batavia. Nat. Tijdschr. Ned.-Indië, 4: 428-516

----------, 1854a. Bijdrage tot de kennis der ichthyologische fauna van de Kokos-Eilanden. Nat. Tijdschr. Ned.- Indië, 9:37-48

----------, 1854b. Bijdrage tot de kennis der ichthyologische fauna van Halmaheira (Gilolo). Nat. Tijdschr. Ned.-Indië, 6:49-62

----------, 1854c. Faunae ichthyologicae Japonicae species novae. Nat. Tijdschr. Ned.-Indië, 6:395-426

----------, 1854d. Vijfde bijdrage tot de kennis der ichyhyologische fauna van Amboina. Nat. Tijdschr. Ned.-Indië, 6:455-508

----------, 1855. Bijdrage tot de kennis der ichthyologische fauna van het eiland Groot-Obij. Nat. Tijdschr. Ned.-Indië, 9:431-38

----------, 1856. Beschrijvingen van nieuwe weinig bekende vischsoorten van Manado en Makassar. Act. Soc. Sc. Indo-Neerl., Menado enMakassar, (1):1-80

----------, 1868. Notice sur la faune ichthyologique de l'île de Waigiou. Versl. Akad. Amsterdam, 2(2):295-301

----------, 1873a. Révision des espèces de *Dentex, Synagris, Gymnocranius, Gnathodentex* et *Pentapus* de l'Inde archipélagique et du Japon. Verh. Akad. Amsterdam, 13:1-64

----------, 1873b. Révision des espèces Indo-archipélagiques du genre *Lethrinus*. Nat. Tijdschr. Dierk., 4: 318-44

----------, 1873c. Mémoire sur la faune ichthyologique de Chine. Ned. Tijdschr. Dierk., 4:113-54

----------, 1873d. Description et figure du *Lethrinus guntheri*. Arch. Néerl. Sci. Nat., 8:153-54, 1 pl.

----------, 1873-76. Atlas ichthyologique des Indes orientales néerlandaises. Fredric Muller, Amsterdam. 7:126 p., pls 279-320

----------, 1876. Systema percarum revisum. Arch. Néerl. Sci. Nat., 11(1):247-88

----------, 1876-77. Atlas ichthyologique des Indes orientales néerlandaises. Fredric Muller, Amsterdam, 8:156 p., pls 321-62

Blevgad, H., 1944. Fishes of the Iranian Gulf. Einer Munksgaard, Copenhagen, 247 p.

Bloch, M.E. & J.G.Schneider, 1801. M E. Blochii Systema Ichthyologiae iconibus cx illustratum. Post obitum auctoris opus inchoatum absolvit, correxit, interpolavit J.G. Schneider, Saxo. Berolini, ix + 584 p.

Bock, K.R., 1978. A guide to common reef fishes of the western Indian Ocean. Macmillan, London, 122 p., 16 pls

Boeseman, M., 1947. Revision of the fishes collected by Burger and von Siebold in Japan. E. J. Brill, Leiden. 28:242 p., 5 pls

Borodin, N.A., 1932. Scientific results of the yacht "Alva" world cruise, July, 1932, in command of William K. Vanderbilt. Bull. Vanderbilt Marine Mus., 1(3):65-101, 2 pls

Brothers, E.B., D. McB. Williams & P.F. Sale, 1983. Length of larval life in twelve families of fishes at "One Tree Lagoon", Great Barrier Reef, Australia. Mar.Biol., 76:319-24

Burgess, W.E. & H. R. Axelrod, 1972 Pacific marine fishes. Book 2. T.F.H Publ Inc., Neptune City, N.J. p. 281-560

----------, 1973. Pacific marine fishes Book 3. Fishes of Sri Lanka (Ceylon), the Maldive Islands and Mombasa. T.F.H Publ.Inc., Neptune City, N J., p 561-834

----------, 1976. Pacific marine fishes. Book 7. Fishes of the Great Barrier Reef. T.F.H.Publ.Inc., Neptune City, N.J., p 1658-1925

Caillard, B & E. Morize, 1986. La production de la pêcherie de l'atoll Tikehae en 1985. Contr. Etude Atoll Tikehau, 3:45-71

Cantor, T., 1849 Catalogue of Malayan fishes. J. Roy Asiat. Soc Bengal, 18:983-1042

Castelnau, C. F., 1873. Contribution to the ichthyology of Australia. No. 5.- Notes on fishes from North Australia Proc. Zool Acclim Soc Victoria, 2:83-97

Castelnau, F. L., 1875. Researches on the fishes of Australia. Phil Centen. Exhib. 1876 (Melbourne, 1875): Official Record. Intercol Exhib Essays, 2:1-52

Chan, W.L. & R.M. Chilvers, 1974 A revision of the Indo-Pacific spariform percoids of the Monotaxinae, with the description of a new genus *Wattsia* Hong Kong Fish Bull., 4:85-95

Chikuni, S. et al., 1972 Colored illustrations of bottomfishes collected by Japanese trawlers. Vol.,1, Japan Deep Sea Trawlers Assoc.,Tokyo, 145 p.

----------, 1976 Colored illustrations of bottomfishes collected by Japanese trawlers Vol. 2 Japan Deep Sea Trawlers Assoc.,Tokyo, 145 p.

Clark, A., 1984. Development prospects for an off-shore reef fish fishery in northern Australian waters. Fish.Rep.Dep.Primary Prod (N.T.), 53 p

Coleman, N., 1980 Australian sea fishes south of 30 degrees S. Doubleday Australia, Lane Cove, NSW., 302 p.

----------, 1981. Australian sea fishes north of 30 degrees S Doubleday Australia, Lane Cove, NSW., 287 p.

Collin, S.P., 1989. Anterograde labelling from the optic nerve reveals multiple central targets in the Teleost *Lethrinus chrysostomus* Perciformes. Cell Tissue Res., 256(2):327-36

Couacaud, L., 1969. Schools of fish and their exploitation. Rev Agr Sucr. Ile Maurice, 48(3):214-15

Craik, G.J.S., 1982. Recreational fishing on the Great Barrier Reef. Proc.Fourth Intl.Coral Reef Symp., 1:47-52

Cuvier, G., 1829 Le règne animal distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. 2nd Edition. Paris. Vol. 2 Poissons. 406 p.

Cuvier, G. & A. Valenciennes, 1830. Histoire naturelle des poissons. F.G.Levrault, Paris. 6:xxiv + 559 p., 30 pls.

Day, F., 1875 The fishes of India: being a natural history of the fishes known to inhabit the sea and fresh waters of India, Burma, and Ceylon. Bernard Quaritch, London, 168 p., 41 pls.

----------, 1889. The fauna of British India, including Ceylon and Burma. Fishes, 2. Taylor and Francis, London. 509 p.

De Vis, C. W., 1884a. On new fish from Moreton Bay. Proc. Royal Soc. Queensland, 1(1):144-47

----------, 1884b. New Australian fishes in Queensland museum. Part II. Proc Linn. Soc. N. S. Wales, 9(3): 453-62

Druzhinin, A.D. & S.V. Busakhin, 1978. Some data on *Gymnocranius griseus* from the northwestern Indian Ocean. J.Ichthyol., 17(1):148-50

Edwards, R. R., C. A. Bakhader & S. Shaher, 1985 Growth, mortality, age composition and fisheries yields of fish from the Gulf of Aden. J. Fish. Biol., 27:13-21

FAO, 1989. Yearbook of fishery statistics. Annuaire statistique des pêches. Anuario estadístico de pesca, 1987. Catches and landings. Captures et quantités débarquées. Capturas y desembarques Yearb Fish Stat./Annu.Stat. Pêches/Anu Estad Pesca, 64:490 p

Fischer, W. & P.J.P. Whithead (eds), 1974 FAO species identification sheets for fishery purposes Eastern Indian Ocean and Western Central Pacific (fishing areas 57 and 71). FAO, Rome Vol.2:pages var

Fischer, W. , G. Bianchi & W. B. Scott (eds), 1981 FAO species identification sheets for fishery purposes Eastern Central Atlantic. (fishing area 34 and part of 47) FAO, Rome Vol.2:pages var

Fischer, W., & G. Bianchi (eds), 1984 FAO species identification sheets for fishery purposes. Western Indian Ocean (fishing area 51). FAO, Rome Vol 2 pages var

Forsskål, P., 1775 Descriptiones animalium avium, amphibiorum, piscium, insectorum, vermium, quae in itinere orientali observavit. Post mortem auctoris edidit Carsten Niebuhr Mollen, Hauniae. 20 + xxxiv + 164 p., 43 pls.

Forster, G. R., 1984. The distribution of fishes on the outer reef slopes of Aldabra (Indian Ocean) in relation to bottom temperatures. Env Biol Fish , 10(3):129-36

Fourmanoir, P., 1961. Liste complémentaire des poissons du canal de Mozambique. Mem. Inst. Sci. Madagascar. Ser.F, 4:83-107

----------, 1982. Répartition géographique de quelques poissons de la pente récifalfe externe des îles Indo-pacifiques. Cybium , 6(3):91-6

Fourmanoir, P. & P. Laboute, 1976 Poissons de Nouvelle Calédonie et des Nouvelles Hébrides Les éditions du Pacifique, Papeete, Tahiti, 367 p

Fowler, H. W., 1904. Collection of fishes from Sumatra. J Acad Nat Sci Philadelphia, 2(12):497-560

----------, 1928 The fishes of Oceania Mem B P Bishop Mus , 10:1-540, pls1-49

----------, 1931a The fishes of Oceania Supplement 1. Mem. B P Bishop Mus., 11(5):1-381, figs 1-7

----------, 1931b. Contributions to the biology of the Philippine Archipelago and adjacent regions. The fishes of the families Pseudochromidae, Lobotidae, Pempheridae, Priacanthidae, Lutjanidae, Pomadasyidae and Teraponidae, collected by the United States Bureau of fisheries steamer ALBATROSS, chiefly in Philippine Seas and adjacent waters Bull. U.S. natn. Mus., 100(11):ix + 388 p., 29 figs.

----------, 1933. Contributions to the biology of the Philippine Archipelago and adjacent regions. The fishes of the families Banjosidae, Lethrinidae, Sparidae, Girellidae, Kyphosidae, Oplegnathidae, Gerridae, Mullidae, Emmelichthyidae, Sciaenidae, Sillaginidae, Arripidae, and Enoplosidae collected by the United States Bureau of fisheries steamer ALBATROSS, chiefly in Philippine seas and ajacent waters Bull. U.S. natn. Mus., 100(12):1-165

----------, 1934 The fishes of Oceania. Supplement 2 Mem B P Bishop Mus., 11(6): 384-466, figs 1-4

----------, 1936 The marine fishes of West Africa Bull. Amer Mus Nat Hist., 70(2):607-1493, figs 276-657

----------, 1938. Studies of Hong Kong fishes No. 3 Hong Kong Naturalist, Supplement, 6:1-52

----------, 1949 The fishes of Oceania. Supplement 3 Mem B P Bisop Mus., 12(2):36-186

----------, 1959 Fishes of Fiji Government of Fiji, Suva, 670 p

Gilchrist, J.F.D. & W.W. Thompson, 1908 Descriptions of fishes from the coast of Natal Ann. S. Afr. Mus., 6:145-206; 213-79

----------, 1909. Descriptions of fishes from the coast of Natal. Part 2. Ann. S. Afr. Mus., 6:213-76

Gloerfelt-Tarp, T. & P.J. Kailola, 1984 Trawled fishes of Southern Indonesia and Northwestern Australia. Australian Development Assistance Bureau, Indonesian Directorate General of Fisheries, German Agency for Technical Cooperation, 406 p

Goeden, G.B., 1982. Intensive fishing and a "keystone" predator species: ingredients for community instability. Biol.Conserv., 22(4):273-81

Grant, C., 1981. High catch rates in Norfolk Island dropline fishery. Austral.Fish., 1981 March:10-13

Grant, E. M., 1982 Guide to fishes Dept Harbors and Manne, Brisbane, 896 p

Guichenot, A., 1865. Faune ichthyologique In Maillard, L.: Notes sur l'île de la Réunion. Appendice C. Paris, 32 p.

Günther, A., 1859 Catalogue of the Acanthopterygian fishes in the collection of the British Museum. Vol. 1. British Museum, London, xxxi + 524 p.

----------, 1873 Andrew Garrett's Fische der Südsee Jour Mus Godeffroy, 2(3):1-128, 83 pls

----------, 1879. Notice of two new species of fishes from the south seas (*Diagramma giganteum, Sphaeodon euanus*) Ann Mag. Nat. Hist., 5(4):136-37

Gushima, K. & Y. Murakami, 1979. Mixed species groupings in reef fishes of Kuchierabu Island, Japan. J.Fac.Appl.Biol. Hiroshima Univ., 18(1):103-22

Harmelin-Vivien, M.L., 1977. Ecological distribution of fishes on the outer slope of Tulear reef (Madagascar). Proc Third Intl Coral Reef Symp :289-95

Hashim, M.T. & A.A. Shakour, 1981. Age determination and growth studies of *Lethrinus mahsena* and *L. xanthochilus*. Jeddah, J Mar Res., 1:11-20

Herre, A. W., 1931. A check list of fishes from the Solomon Islands J. Pan-Pacific Res. Inst., 6 (4):4-9

----------, 1935 New fishes obtained by the Crane Pacific Expedition. Field Mus. Nat. Hist. (Zool.), 18 (12):383-438

----------, 1953. Checklist of Philippine fishes U S Gov Print.Off., Washington,D.C., 977 p

Herre, A.W. & H.R. Montalban, 1927. Philippine sparoid and rudder fishes Phil. Jour. Sci., 33(4):397-441, 9 pls.

Huang, T.-S. & J.-L. Yen, 1985. Embryonic and larval development of the scavenger, *Lethrinus nebulosus*. Bull Taiwan Fish Res Inst., 38:147-55

Hutchins, B. & R. Swainston, 1986 Sea fishes of southern Australia Swainston Publishing, Perth, 180 p

Johannes, R. E., 1981. Words of the Lagoon. Univ California Press, Berkeley, 245 p.

Johnson, G.D., 1981. The limits and relationships of the Lutjanidae and associated families Bull Scripps Inst. Ocean, (for 1980) 24:1-114

----------, 1984 Percoidei: development and relationships Ontogeny and systematics of fishes Amer.Soc. Ich Herp. Spec. Publ., 1:464-98

Jones, S. & M. Kumaran, 1980 Fishes of the Laccadive Archipelago. Nat Cons Aquat Sci. Serv., Kerala, India, 760 p.

Jordan, D.S. & B.W. Evermann, 1905. The aquatic resources of the Hawaiian Islands I. The shore fishes of the Hawaiian Islands, with a general account of the fish fauna Bull U.S.Fish Comm. for 1903, 23(1):i-xxviii, 1-574, 229 figs, 73 + 65 pls

Jordan, D.S. & A. Seale, 1906. The fishes of Samoa. Bull Bur Fish, 25:173-455, pls 33-53

Jordan, D.S. & W. F. Thompson, 1912. A review of the Sparidae and related families of perch-like fishes found in the waters of Japan. Proc U. S Natl Mus., 41(1875):521-601

Katzir, G. & E. Schechtman, 1986. Interactions during feeding among certain coral reef fishes in Elat. Mar.Biol., 91:441-47

Kedidi, S. M., 1984. Stock assessment for the Redspot Emperor *Lethrinus lentjan* from areas adjacent to Suakin and Muhammad Qol (Sudan) survey conducted during 1982-1984 FAO, Rome, Italy RAB/83/023/07, 27 p

Kedidi, S. M. & M. Bouhlel, 1985. Stock assessment for the Longface Emperor *Lethrinus miniatus* from the Djiboutian waters Red Sea - Gulf of Aden. FAO, Rome. RAB/83/023/12, 25 p.

Kedidi, S. M., T. Abushusha & K. Allam, 1984 Biology and stock assessment of the Redspot Emperor, *Lethrinus lentjan* from waters adjacent to Tuwwal, Saudi Arabia FAO, Rome RAB/81/002/15, 21 p

Kendall, W. C. & E. L. Goldsborough, 1911. Reports on the scientific results of the expedition to the tropical Pacific, in charage of Alexander Agassis, by the U.S. Fish Commission Steamer "Albatross" Mem. Mus. Comp. Zool., 27(7):241-343

Kittlitz, F. H. von, 1858. Denkwurdigkeiten einer Reise nach dem russischen America, nach Mikronesien und durch Kamtschatka. Gotha, 2:1-463

Klausewitz W. & J.G. Nielsen, 1965. On Forsskål's collection of fishes in the zoological museum of Copenhagen. Spolia Zool. Mus. Hauniensis, 22:1-29, 38 pls

Klunzinger, C.B., 1870. Synopsis der Fische des Rothen Meeres. Verh. Zool.-Bot. Ges. Wien, 20:669-834

Klunzinger, C.B., 1884. Die Fische des Rothen Meeres. E. Schweizerbar'sche, Stuttgart, 133 p.

Kner, R., 1865-67. Fische. In Reise der österreichischen Fregatte NOVARRA um die Erde in den Jahren 1857-1859, unter den Befehlen des Commodore B. von Wullerstorf-Urbair. Zoologischer Theil, (1-3), 433 p., 16 pl. (1865: 1-272, pl. I-XI; 1867:273-433, pl. XII-XVI

Kojima, J., 1985. Description of a juvenile of the lethrinid fish, *Gymnocranius griseus*, with comments on its relationships. Rep. Mar. Ecol. Res. Inst., Chiba Pref., (8S101), 13 p. (Japanese with English summary)

Kossmann, R. A & H. Räuber, 1877. Fische. In Zoologische Ergebnisse einer im Auftrage der königlichen Akademie der Wissenschaften zu 8erlin ausgeführten Reise in die Küstengebiete des Rothen Meeres. Erste Abtheilung, Leipzig, p. 37S-420

Kuo, C.-L., 1988. The study of fishery biology on porgies *Lethrinus nebulosus* Forsskål in waters of Australia. Sino-Jap.Colloq.Asess Manag Mar.Fish Res :12S-31

Kuronuma, K. & Y. Abe, 1972. Fishes of Kuwait. Kuwait Inst. for Sci. Res., 123 p., 20 pls

----------, 1986. Fishes of the Arabian Gulf. Kuwait Inst. for Sci. Res., 3S7 p., 30 pls

Kyushin, K. et al., 1977. Fishes of the Indian Ocean. Japan Mar.Fish.Resour Res.Center, Tokyo, 392 p.

----------, 1982. Fishes of the South China Sea. Japan Mar.Fish Resour.Res Center, Tokyo, 333 p.

Lacepède, B.G., 1802. Histoire naturelle des poissons. Chez Plassan, Paris, Vol 4, xliv + 728 p., 16 pls

Lagraulet, J. et al., 1972. A propos of the poisoning of the 8ec-de-cane fish belonging to the Lethrinidae family. 8ull. Soc. Pathol. Exot., 6S(S):733-37

Lebeau, A. & J.-C. Cueff, 1975. 8iologie et pêche du capitaine *Lethrinus enigmaticus* (Smith, 1959) du band de Saya de Malha (Ocean Indien). Rev. Trav. Inst. Pêches marit., 39(4):41S-42

Lee, S.-C., 1982. The family Monotaxidae (Pisces.Perciformes) of Taiwan. Bull. Inst. Zool., Acad. Sinica, 21(2):155-60

----------, 1986. Fishes of the genus *Lethrinus* (Percoidi:Lethrinidae) of Taiwan. 8ull. Inst. Zool., Acad.Sinica, 2S(1):79-89

Leis, J.M. & D.S. Rennis, 1983. The larvae of Indo-Pacific coral reef fishes. New South Wales University Press, Sydney and University of Hawaii Press, Honolulu, 269 p.

Lindberg, G. U. & Z. V. Krasyukova, 1971. Fishes of the Sea of Japan and the adjacent areas of the Sea of Okhotsk and the Yellow Sea. Israel Prog. Sci. Transl., Jerusalem, 498 p

Lindberg, G. U., A. S. Heard & T. S. Rass, 1980. Multilingual dictionary of names of marine food-fishes of world fauna. Ministry of Fisheries of the USSR, S62 p.

Loubens, G., 1978. Biologie de quelques espèces de poissons du lagon néo-calédonien I. Determination de l'age (otolithométrie). Cah. O. R. S. T. O. M., sér. Océanogr., 16(3-4):263-83

----------, 1980a. Biologie de quelques espéces de poissons du lagon néo-calédonien II: Sexualité et reproduction. Cah. Indo-Pac., 2(1):41-72

----------, 1980b. Biologie de quelques espéces de poissons du lagon néo-calédonien III: Croissance. Cah. Indo-Pac., 2(2):101-S3

Macleay, W., 1878. The fishes of Port Darwin. Proc. Linn. Soc. New South Wales, 2:344-66

----------, 1883. Contribution to a knowledge of the fishes of New Guinea. Proc. Linn. Soc. New South Wales, 7:224-S0

Marshall, T. C., 1966 Tropical fishes of the Great Barrier Reef. Angus & Robertson Pub., London, 126 p., 136 pls

Masuda, H., C. Araga & T. Yoshino, 1975 Coastal fishes of southern Japan. Tokai University Press, Tokyo, 382 p.

Masuda, H., et al. (eds), 1984 The fishes of the Japanese Archipelago. Tokai University Press, Tokyo, 437 p., 370 pls

Meunier, F.J. & M. Pascal, 1980. Some comparative data on the cyclical growth of skeletal tissues in Osteichthyans. Bull.Soc.Zool.Fr., 105(2):337-42

Meunier, F.J., M. Pascal & G. Loubens, 1979. Comparaison de méthodes squelettochronologiques et considérations fonctionnelles sur le tissu osseux acellulaire d'un ostéichthyen du lagon Néo-Calédonien, *Lethrinus nebulosus*. Aquaculture, 17:137-57

Mito, S., 1956. On the egg development and hatched larvae of *Lethrinus nematacanthus* Bleeker. Sci Bull.Fac.Agric. Kyushu Univ., 15:497-500

Monkolprasit, S., 1984. Economic coral reef fishes found in Thai waters Proc Symp Recen Res Coral Reefs:55-62

Morales-Nin, B., 1988. Age determination in a tropical fish *Lethrinus nebulosus* (Forsskål, 1775) (Teleostei, Lethrinidae) by means of otolith interpretation. Invest Pesq , 52(2):237-44

Munro, I.S.R., 1955 The marine and freshwater fishes of Ceylon. Dept External Affairs, Canberra, 351 p., 56 pls

----------, 1967. The fishes of New Guinea Dept Agric.,Stock & Fish. Port Moresby New Guinea, 650 p.,78 pls

Munro, J.L. & D. McB. Williams, 1985 Assessment and management of coral reef fisheries: biological, environmental and socio-economic aspects Proc.IV Intl Coral Reef Congress, Tahiti, 4:545-81

Myers, R. F., 1989. Micronesian reef fishes. Coral Graphics Production, Guam, 298 p.

Myers, R.F. & J.W. Shepard, 1980. New records of fishes from Guam, with notes on the ichthyofauna of the southern Marianas. Micronesica, 16(2):305-47

Nelson, J.S., 1984. Fishes of the world Wiley Interscience Publication, 523 p.

Norman, J. R., 1966 A draft synopsis of the orders, families and genera of recent fishes and fish-like vertebrates. Trustees Brit.Mus.(Nat Hist.), London, 649 p.

Oda, D.K. & J.D. Parrish, 1982. Ecology of commercial snappers and groupers introduced to Hawaiian waters. Proc Fourth Intl Coral Reef Symp., 1:60-7

Ogilby, J. D., 1912. On some Queensland fishes. Mem. Queensland Mus., 1:26-65, 14 pls

----------, 1916 Edible fishes of Queensland. Mem. Queensland Mus., 5:127-77, pls 14-23

Pauly, D. & R.S.V. Pullin, 1988. Hatching time in spherical, pelagic, marine fish eggs in response to temperature and egg size. Env Bio. Fishes, 22(4):261-72

Peters, W., 1868 Über die von Hrn Dr. F Jagor in dem ostindischen Archipel gesammelten Fische. Monatsber. Akad Wiss Berlin, 1868:254-81

Pitt, R., O.Tsur & H. Gordin, 1977. Cage culture of *Sparus aurata*. Aquaculture, 11:285-96

Playfair, R.L. & A. Günther. 1866 The fishes of Zanzibar, with a list of the fishes of the whole East coast of Africa John van Voorst, London, xiv + 153 p , 21 pls

Postel, E., 1965 Deux lutjanidés nouveaux des environs de Nouméa (Nouvelle-Calédonie). Bull.Mus.natn.Hist.nat., Paris, (2)37(2): 244-51

Randall, J.E., 1955. Fishes of the Gilbert Islands Atoll Res Bull., 47:1-243

----------, 1979. A survey of ciguatera at Enewetak and Bikini, Marshall Islands, with notes on the systematics and food habits of ciguatoxic fishes Fish Bull., 78(2):201-49

----------, 1983. Red Sea reef fishes Immel Publishing, London, 192 p.

----------, 1986. 106 new records of fishes from the Marshall Islands Bull Mar Sci., 38(1):170-252

Randall, J.E., G.R. Allen & W.F. Smith-Vaniz, 1978. Illustrated identification guide to commercial fishes. Regional fishery survey and development project Bahrain, Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates. Rome, FAO UNDP, FI:DP/RAB/71/278/3, 221 p

Rashid, M.H. & M.R. Qureshi, 1967. Fishes belonging to the families Lethrinidae, Pentapodidae, Sparidae, Mullidae, Monodactylidae, Pempheridae, Tonotidae and Kyphosidae (Order Percomorphi) Sci Res Quart J East Res Lab.PCSIR., 4(2-3):89-99

Rau, N. & A. Rau, 1980. Commercial fishes of the Philippines Deutsche Gesellschaft fur Technische Zusammenarbeit, Eschborn, 623 p.

Reed, W., 1964. Red sea fisheries of Sudan. Government Printing Press, Khartoum, 116 p

Relyea, K., 1981 Inshore fishes of the Arabian Gulf George Allen & Unwin, London, 149 p., 8 pls

Renzhai, Z. & L. Suifen, 1980 Studies on the eggs and larvae development of wise porgy, *Gymnocranius griseus* (Temminck et Schlegel). Acta Zool Sinica, 26(2):132-35

Richardson, J., 1843. Icones piscium. Richard and John E. Taylor, London, 8 p , 5 pls

----------, 1844. Ichthyology. In R.B. Hinds (ed): The zoology of the voyage of H.M S SULPHUR under the command of Captain Sir Edward Belcher, during the years 1836-42 Part 3, p 51-150, 30 pls Smith, Elder and Co., London

----------, 1846 Report on the ichthyology of the seas of China and Japan. Rep Brit Assoc Adv Sci.15th Meet., (1845):187-320

----------, 1848. Ichthyology. In J. Richardson & J.E. Gray: The zoology of the voyage of HMS EREBUS and TERROR under the command of Capt. Sir J.C. Ross during 1839-43 London, Part 4:p. i-viii + 75-139

Rüppell, W.P.E., 1838. Fische des rothen Meers In Neue Wirbelthiere zu der Fauna von Abyssinien gehörig Siegmund Schmerber, Frankfurt am Main, part 4: p 81-148, pls 22-33

Russell, B.C., 1983. Annotated checklist of the coral reef fishes in the Capricorn-bunker group Great Barrier Reef Australia. Great Barrier Reef Authority, Queensland, 184 p., 49 pls.

Russell, P., 1803 Descriptions and figures of two hundred fishes collected at Vizagapatam on the coast of Coromandel East India Co., London, 1:vii + 78 p , figs ic

Sainsbury, K.J., 1979. CSIRO defining fish stocks on NW shelf Austral Fish March:4-12

Sainsbury, K.J., P.J. Kailola & G.G. Leyland, 1985 Continental shelf fishes of Northern and North-Western Australia. CSIRO, Canberra, Commonwealth of Australia, 375 p

Samboo, R., 1982. The Mauritius banks fishery Swio Fish Bull Pêches Oiso, 2:9-12

Sanders, M.J., S.M. Kedidi & M.R. Hegazy, 1984. Stock assessment for the spangled emperor *Lethrinus nebulosus* caught by small scale fishermen along the Egyptian Red Sea coast FAO, Rome. RAB/83/023/01, 41 p

Sano, M., M. Shimizu, & Y. Nose, 1984 Food habits of teleostean reef fishes in Okinawa Island, Southern Japan. Univ.Mus.,Univ.Tokyo Bull., 25:1-128

Sato, T., 1971. A revision of the Japanese sparoid fishes of the genus *Lethrinus*. J Fac Sci , Univ Tokyo Sec 4, 12(2):117-44

----------, 1978. A synopsis of the sparoid fish genus *Lethrinus* with the description of a new species. Univ Mus., Univ.Tokyo Bull., 15:1-70, 35 figs, 12 pls

----------, 1984. Lethrinidae See Fischer, W & G Bianchi (eds)

----------, 1986. A systematic review of the sparoid fishes of the subfamily Monotaxinae. In Uyeno T. et al. (eds) Indo-Pacific Fish Biology. Proc Sec Intl Conf.Indo-Pac Fishes, Tokyo Ichthyological Society of Japan, 602-12

Sauvage, H.E., 1875 Poissons In A. Grandidier: Histoire physique, naturelle et politique de Madagascar. Imprimerie nationale, Paris, Vol 16, 543 p., 61 pls

Copyrighted material

Saville-Kent, W., 1893. The Great Barrier Reef of Australia; its products and potentialities. W H Allen, London.

Schroeder, R.E., 1980. Philippine shore fishes of the Western Sulu Sea. Nat.Media Prod.Center, Manila, 266 p.

Schultz, L.P. et al., 1953. Fishes of the Marshall and Marianas Islands. U S Natl Mus Bull., 202:1-685

Seale, A., 1909. New species of Philippine fishes. Phil.Jour Sci., 4(6):491-543, pls 1-13

Seale, A. & B. A. Bean, 1907. On a collection of fishes from the Philippine Islands, made by Maj. Edgar A. Mearns, Surgeon, U.S. Army, with descriptions of seven new species. Proc U S. Natl.Mus., 33(1568):229-48

Senta, T., 1973. A new sparoid fish, *Gymnocranius elongatus* from the southern South China Sea. Jap J. Ich., 20(3):135-44

Shao, K.-T., S.-R. Kuo & C.-C. Lee, 1987. Eleven new records of fishes from Taiwan. J.Taiwan Mus., 39(2):111-22

Shen, S.-C., 1984. Coastal fishes of Taiwan. Shih-Chieh Shen (Private Printing), Taiwan, 190 p.

Shinohara, S., 1963. A review of the Lethrinidae found in the waters of Ryukyu. Ryukyu Daigaku Bunri-gakubu Kiyo (Ri. gaku-hen), May 1963:38-48

Silas, E. G. & H. S. Toor, 1962. On some new records of pigface breams (Family Lethrinidae:Pisces) from the Andaman Sea. J.Mar Biol Ass India, 3:208-14

----------, 1963. *Lethrinella conchyliatus* Smith (Lethrinidae:Pisces), a new record for Indian Seas. J Mar Biol.Ass India, 4:243-45

Sivalingam, S., 1969. Wadge Bank trawl fishery studies, Part 4. An analysis of the length frequency measurements of the sea bream *Lethrinus nebulosus* in 1949 and 1953 to 1958. Bull.Fish Res.Sta.,Ceylon, 20(1):39-50

Smith, J.L.B., 1941. The genus *Gymnocranius* Klunzinger, with notes on certain rare fishes from Portuguese East Africa. Trans Roy Soc S.Afr., 28(S):441-52, 58 pls

----------, 1953. The sea fishes of southern Africa. Central News Agency, Ltd., Cape Town, 3rd ed., 564 p., 107 pls

----------, 1955. New species and new records of fishes from Mozambique. Part I. Mem Mus de Castro, 3:3-27, 3 pls

----------, 1957. Deep-line fishing in northern Mozambique, with the description of a new pentapodid fish. Ann Mag nat Hist., (12)10:121-24, 1 pl.

----------, 1959. Fishes of the family Lethrinidae from the western Indian Ocean. Ichth Bull Rhodes Univ., 17:285-295, pls 20-25

Smith, J. L. B. & M. M. Smith, 1963. The fishes of the Seychelles. Rhodes University, Grahamstown, 215 p., 98 pls

Smith, M.M., 1986. Lethrinidae. In Smith, M. & P.C. Heemstra (eds): Smiths' Sea Fishes. J.L.B. Smith Institute of Ichthyology, Grahamstown, 1047 p., 144 pls

Sousa, M.I. & M. Dias, 1981. Catalogo de peixes de Moçambique - Zona Sul. Inst Desenv Pesq., Maputo, 121 p.

Steindachner, F., 1866. Ichthyologische Mittheilungen. IV, Über einige neue oder wenig gekannte Fische von Zanzibar. IX Verh Zool-Bot Ges Wien, 16:778-82

----------, 1882. Beitrage zur Kenntniss der Fische Afrika's und Beschreibung einer neuen Sargu-art von den Galapagos-Inseln. Denks Kaiser Akad Wiss Wien, 44(1):19-58

Stroemme, T., 1986. Pelagic and demersal fish resources of Oman. Results of the R/V Fridtjof Nansen surveys in Oman, 1983-84. UNDP/FAO Programme GLO/82/001

Suzuki, K. & S. Hioki, 1978. Spawning behavior, eggs, and larvae of the sea bream, *Gymnocranius griseus*, in an aquarium. Jap J. Ich., 24(4):271-77

Tawada, S., 1983. Studies on the seedling production of Lethrinous fish *Lethrinus nebulosus* Forsskål. The natal spawning in using large-scale out-door tanks. Aquaculture, 31(2):60-6

Taylor, W.R., 1964. Fishes of Arnhem land. Rec Amer -Aust Sci Exp Arnhem Land, Zool. 4:45-308

Temminck, C.J. & H. Schlegel, 1842-50. Pisces. In P.F. von Siebold: Fauna Japonica, sive descripto animalium quae in itinere per Japoniam suscepto annis 1823-30 collegit, etc. Lugduni Batavorum, 323 p., 160 pls.

Thresher, R.E., 1984. Reproduction in reef fishes. TFH Publications, Neptune City, N.J., 399 p.

Toor, H.S., 1964. Biology and fishery of the pig-face bream, *Lethrinus lentjan* Lacepède. Indian J. Fish., Sect. A, 11(2):559-620.

----------, 1966. On the occurrence of *Lethrinus mahsenoides* in the Indian waters with a note on *Lethrinus sanguineus*. Proc. Indian Sci. Congr., 53(3):378.

----------, 1973. Taxonomic position of *Lethrinus mahsenoides* and *Lethrinus sanguineus*. Res. Bull. Panjab Univ. Sci., 22(3-4) (1971-1972):375-8.

Valenciennes, A., 1862. Description de quelque espèces nouvelles de poissons envoyées de Bourbon par M. Morel. C.R. Acad. Sci., Paris, 54:1165-70, 1201-7.

Vivien, M., 1973. Ecology of the fishes of the inner coral reef flat in Tulear (Madagascar). J. Mar. Biol. Ass. India, 15(1):20-45.

Walker, M.H., 1975. Aspects of the biology of emperor fishes, family Lethrinidae, in North Queensland Barrier Reef waters. unpubl., Ph.D. diss., Dept. Zoology, James Cook Univ. N. Queesl.

----------, 1978. Food and feeding habits of *Lethrinus chrysostomus* Richardson (Pisces: Perciformes) and other lethrinids in the Great Barrier Reef. Aust. J. Mar. Fresh. Res., 29(5):623-30.

Weber, M., 1913. Die Fische der Siboga-Expedition. Siboga Rep., 57:1-710, 12 pls.

Weber, M. & L.F. de Beaufort, 1936. The Fishes of the Indo-Australian Archipelago, 7. Perciformes (continued). E.J. Brill, Leiden, 607 p., 106 figs.

Wheeler, J.F.G., 1961. The genus *Lethrinus* in the Western Indian Ocean. Col. Off. Fish Pub., London, 15:1-51, 3 pls.

Wheeler, J.F.G. & F.D. Ommanney, 1953. Report on the Mauritius - Seychelles fisheries survey 1948-1949. I: The bottom fishes of economic importance. Col. Off. Fish Pub., London, 1(3):1-145.

White, A. W. & M. A. Barwani, 1971. Common sea fishes of the Arabian Gulf and Gulf of Oman, 170 p.

Whitehead, P.J.P., 1969. The Reeves collection of Chinese fish drawings. Bull. Br. Mus. nat. Hist. (hist. Ser.), 3(7):193-233, 30 pls.

Whitley, G.P., 1929. Studies in ichthyology. No. 3. Rec. Austral. Mus., 17(3):101-43, pls 30-34.

----------, 1932. Studies in ichthyology. Rec. Austral. Mus., 18(6):321-48.

----------, 1933. Studies in ichthyology. No. 7. Rec. Austral. Mus., 19:60-112.

----------, 1936. More ichthyological miscellanea. Mem. Queensland Mus., 11(1):21-52.

----------, 1943. Ichthyological descriptions and notes. Proc. Linn. Soc. New South Wales, 68:114-44, pls 3-4.

Williams, D. McB. & A.I. Hatcher, 1983. Structure of fish communities on outer slopes of inshore, mid-shelf and outer shelf reefs of the Great Barrier Reef. Mar. Ecol. Prog. Ser., 10(1983):239-50.

Winterbottom, R., A.R. Emery & E. Holm, 1989. An annotated checklist of the fishes of the Chagos Archipelago, Central Indian Ocean. Royal Ontario Museum, 226 p., 454 figs.

Wray, T. (ed.), 1979. Commercial fishes of Saudi Arabia. White Fish Authority, U.K., 120 p.

Wu, R.S.S. & N.Y.S. Woo, 1983. Tolerance of hypo-osmotic salinities in thirteen species of adult marine fish: implications for estuarine fish culture. Aquaculture, 32:175-81.

Young, P.C. & R.B. Martin, 1982. Evidence for protogynous hermaphroditism in some lethrinid fishes. J. Fish. Biol., 21:475-84.

6. INDEX OF SCIENTIFIC AND VERNACULAR NAMES

EXPLANATION OF THE SYSTEM

The index applies exclusively to the genera and species accounts (Section 2.3 Information by Species)

Type faces used:

Italics (bold)	:	Valid scientific names (double entry by genera and species)
Italics	:	Synonyms (double entry by genera and species)
Roman (bold)	:	International (FAO) species names
Roman	:	Local species names

Copyright Restricted

A

Aaravi 80
abbreviatus, Lethrinus 69
acutus, Lethrinus 71
Adia 80
affinis, Monotaxis 24
alboguttatus, Lethrinus 75
Ama-kuchibi 58
amamianus, Lethrinus 73
amboinensis, Lethrinus 47
Ambon emperor 47
Ami-fuefuki 85
anarhynchus, Lethrinus 66
anatarius, Lethrinus 75
Angana 92
argenteus, Lethrinus 67
atkinsoni, Lethrinus 48
Atlantic emperor 50
atlanticus, Lethrinus 50
Atlantikkehrer 51
audleyi, Gymnocranius 22
aureo-lineatus, Sparus 17
aurollneatus, Gnathodentex 17
aurolineatus, Lethrinus 75
azureus, Lethrinus 64

B

Bakuktuk 58
Bariadiva 28
Barialava 28
Barrois 90
Batardé 65
Batilya 48,49,60,69,80
Battadet 65
Baxou 84
Baxou goemon 89
Bec de cane 76
Bec de cane malabar 80
Berri bâtard 65
Bica 51
Bigeye barenose 92
Bitilya 65,76,78,81,82, 84,85,88,89,90
bitorquatus, Gymnocranius 22
Black-blotch emperor 65
Black blotch emperor 84
Blackeye emperor 56
Blacknape large-eye bream 31
Blackspot emperor 65
bleekeri, Lethrinus 64
Blou keiser 76
Blue emperor 76
Blue-lined large-eye bream 27
Blue-spotted large-eye bream 30
Bondu 18
bonhamensis, Lethrinus 64
borbonicus, Lethrinus 51
Bossu blanc à nageoires roses 32
Bossu blanc à points noirs 25
Bossu blanc grosserace 28
Bossu d'herbe 78
Bossu doré 49
Bossu rond 84
Bossu tache 65
Bossu varié 84
Brème aux gros yeux 92
Brown kelp-fish 67
Budia 92
bungus, Lethrinus 51

C

caeruleus, Lethrinus 69
Cailla 84
Cantharus grandoculis 27
Capitaine 76
Capitaine blanc 28
Capitaine créole 76
Capitaine gueule longue 72,80
Capitaine rouge 58,76
Carandine 18
carinatus, Lethrinus 75
Carri carri 67
centurio, Lethrinus 75
Changu 52,55,58,69, 71,78,80,84
Changu chole 52
Changu doa 65
Changu kabaka 65
Changu kidogo 52
Changu kidra 65
Changu koko 76
Changu kole 65
Changu m'domo 90
Changu m'zizi 76
Changu mdomo 80
Changu myamvi 72
Changu n'doba 90
Changu n'domo 72
Changu n'jana 69
Changu n'yavi 90
Changu ndizi 65
Changu nyamvi 76,84
Changu tewa 76
Changu tuku 71
Changu tuku-mwani 58
Cheekkani 18
Chinese emperor 63

choerorynchus, Lethrinus 75
chrysostomus, Lethrinus 73
Chudch 78
Chuttommette 65
cinereus, Lethrinus 67
cinnabarinus, Lethrinus 57
cocosensis, Lethrinus 67
Collared large-eye bream 22
Collared sea bream 23
Communard 62
conchyliatus, Lethrinus 53
Coral bream 67
Créole 76
croceopterus, Lethrinus 67
crocineus, Lethrinus 54
curtus, Pentapus 27
cutambi, Lethrinus 77
cyanoxanthus, Lethrinus 75

D

Dame berri 71
Dame berri blanc 71
Dame berry 78
Dapak 92
Daryya 81
Dathi 92
Dentex griseus 28
Dentex lethrinoides 27
Dentex lycogenis 17
Dentex microdon 30
Dentex rivulatus 27
Dentex robinsoni 27
devisianus, Lethrinus 75
Drab emperor 87
Dragi 69
dux, Pentapus 27

E

Eclair 76
elongatus, Gymnocranius 23
elongatus, Lethrinus 71
En-bas-la-cendre 65
enigmaticus, Lethrinus 55
erythracanthus, Lethrinus 57
erythropterus, Lethrinus 59
erythrurus, Lethrinus 75
esculentus, Lethrinus 75
euanus, Gymnocranius 24

F

fasciatus, Lethrinus 75
Filolu 65,71
flavescens, Lethrinus 67
fletus, Lethrinus 66
floridus, Lethrinus 53
Forktail large-eye bream 23
fraenatus, Lethrinus 75
frenatus, Gymnocranius 25
Fuefuki-dai 64
fusciceps, Lethrinus 67

G

Gadeer 76,80
Gahash-al-haraq 65
Gahash harak 65
Gahash ma haraq 65
Gapas-gapas 18,30,92
Gawasa 80
Geelip keiser 90
geniguttatus, Lethrinus 67
genivittatus, Lethrinus 61
Glowfish 18
glyphodon, Lethrinus 67
Gnathodentex 17
Gnathodentex aurolineatus 17
Gnathodentex mossambicus 93
Gnathodentex ocumaculatus 17
Gold-lined sea bream 18
gothofredi, Lethrinus 75
grandoculis, Cantharus 27
grandoculis, Gymnocranius 27
grandoculis, Monotaxis 91
grandoculis, Sciaena 91
Grass emperor 66
Grass sweetlip 67
Grey barenose of Grys kaalneus 30
Grey large-eye bream 28
Grey sweetlip 67
griseus, Dentex 28
griseus, Gymnocranius 28
Gueule de vin 54,80
Gueule longue 72
Gueule rouge 74
Guitora 80
guentheri, Lethrinus 75
Gwasawa 65,69
Gymnocranius 18
Gymnocranius audleyi 22
Gymnocranius bitorquatus 22
Gymnocranius elongatus 23
Gymnocranius euanus 24
Gymnocranius frenatus 25

Gymnocranius grandoculis 27
Gymnocranius griseus 28
Gymnocranius japonicus 24
Gymnocranius lethrinoides 31
Gymnocranius microdon 30
Gymnocranius orbis 28
Gymnocranius rüppellii 27
Gymnocranius sp 31

H

haematopterus, Lethrinus 63
Hama-fuefuki 76
Hana-fuefuki 81
harak, Lethrinus 64
Hemel-keiser 71
heterodon, Pagrus 91
Hini gadeya 78
Hôaka-kuchibi 84
Hoso-fuefuki 89
Hota ula 80
Humpnose big-eye bream 91
Husutoni 76
hypselopterus, Lethrinus 59

I

Ikan gigi oran 92
imperialis, Lethrinus 73
indica, Monotaxis 91
insulindicus, Lethrinus 80
Iodine sea bream 24
Iso-fuefuki 49,71
Ito-fuefuki 62
Itotch 65

J

jagorii, Lethrinus 84
Japanese large-eye bream 24
Japanese sea bream 25
japonicus, Gymnocranius 24
johnii, Lethrinus 64

K

kallopterus, Lethrinus 57
Kamoguchi-fuefuki 67
karwa, Lethrinus 75
Kataaka-fuefuki 54
Katambak 48,49,58,60,65, 69,76,78,80,81,82, 84,85,88,89,90
Kawa 65
Kaya 84
Kaya la gueule rouge 54,80
Kibaba 65
Kibora 90
Kilawan 48,49,65,69,76,78,80, 81,82,84,85,88,89,90
Kilukkam-metti 90
Kitsune-fuefuki 80
Kiuwa 76
Koke-nokogiri 94
Kolwang-keiser 84
korely, Lethrinus 75
Kuchibeni-fuefuki 60
Kutot 62

L

Ladrao 76
Lancer 62
Langneus-keiser 80
Lascar 55,57,71,78
Lascar créole 65
laticaudis, Lethrinus 66
latidens, Lethrinus 91
latifrons, Lethrinus 88
Laway laway 62
lentjan, Lethrinus 67
Lethrinella 33
Lethrinichthys 33
lethrinoides, Dentex 27
lethrinoides, Gymnocranius 31
Lethrinus 33
Lethrinus à museau long 80
Lethrinus abbreviatus 69
Lethrinus acutus 71
Lethrinus alboguttatus 75
Lethrinus amamianus 73
Lethrinus amboinensis 47
Lethrinus anarhynchus 66
Lethrinus anatarius 75
Lethrinus argenteus 67
Lethrinus atkinsoni 48
Lethrinus atlanticus 50
Lethrinus aurolineatus 75
Lethrinus azureus 64
Lethrinus bleekeri 64
Lethrinus bonhamensis 64
Lethrinus borbonicus 51
Lethrinus bungus 51
Lethrinus caeruleus 69
Lethrinus carinatus 75
Lethrinus centurio 75
Lethrinus choerorynchus 75

Copyright Museum

Lethrinus chrysostomus 73
Lethrinus cinereus 67
Lethrinus cinnabarinus 57
Lethrinus cocosensis 67
Lethrinus conchyliatus 53
Lethrinus croceopterus 67
Lethrinus crocineus 54
Lethrinus cutambi 77
Lethrinus cyanoxanthus 75
Lethrinus devisianus 75
Lethrinus elongatus 71
Lethrinus enigmaticus 55
Lethrinus erythracanthus 57
Lethrinus erythropterus 59
Lethrinus erythrurus 75
Lethrinus esculentus 75
Lethrinus fasciatus 75
Lethrinus flavescens 67
Lethrinus fletus 66
Lethrinus floridus 53
Lethrinus fraenatus 75
Lethrinus fusciceps 67
Lethrinus geniguttatus 67
Lethrinus genivittatus 61
Lethrinus glyphodon 67
Lethrinus gothofredi 75
Lethrinus guentheri 75
Lethrinus haematopterus 63
Lethrinus harak 64
Lethrinus hypselopterus 59
Lethrinus imperialis 73
Lethrinus insulindicus 80
Lethrinus johnii 64
Lethrinus kallopterus 57
Lethrinus karwa 75
Lethrinus korely 75
Lethrinus laticaudis 66
Lethrinus latidens 91
Lethrinus latifrons 88
Lethrinus lentjan 67
Lethrinus longirostris 78
Lethrinus maculatus 75
Lethrinus mahsena 69
Lethrinus mahsenoides 67
Lethrinus microdon 71
Lethrinus miniatus 73
Lethrinus moensii 84
Lethrinus nebulosus 75
Lethrinus nematacanthus 61
Lethrinus nuageux 76
Lethrinus nubilis 67
Lethrinus obsoletus 77
Lethrinus olivaceus 78
Lethrinus opercularis 67
Lethrinus ornatus 80
Lethrinus papuensis 64
Lethrinus perselectus 75
Lethrinus reticulatus 81
Lethrinus rhodopterus 64
Lethrinus richardsoni 63
Lethrinus rostratus 78
Lethrinus rostratus specificus 78
Lethrinus rubrioperculatus 83
Lethrinus sanguineus 69
Lethrinus scoparius 75
Lethrinus semicinctus 84
Lethrinus sordidus 84
Lethrinus sp. 1 86
Lethrinus sp. 2 87
Lethrinus striatus 59
Lethrinus variegatus 88
Lethrinus virescens 67
Lethrinus waigiensis 78
Lethrinus xanthochilus 89
Lethrinus xanthopterus 78
Lethrinus xanthotaenia 80
Levovangan 92
Lipper 74
Lobotes microprion 28
Long-nosed emperor 80
Longface emperor 79
Longfin emperor 59
longirostris, Lethrinus 78
Longnose emperor 80
Longnose pigface bream 80
Longspine emperor 61
Lumo-an 62
lycogenis, Dentex 17

M

M'cha kufa 65
M'changu 76
maculatus, Lethrinus 75
Madas 49
Maene 18
Mafuti 65,84
Magauli 78
mahsena, Lethrinus 69
mahsenoides, Lethrinus 67
Mailafo'u 78
Makarimas 65
Malaking-mata 92
Maldive emperor 86
Mamamu 92
Manahala 18
Manukena 90
marshalli, Paradentex 27
Mata'ele'ele 65
Mato-fuefuki 65
Mechur 72
Meichidai 30
Meko 80
Metngui 69
Metti 65,71,78
microdon, Dentex 30
microdon, Gymnocranius 30
microdon, Lethrinus 71
microprion, Lobotes 28
miniatus, Lethrinus 73

Mlangmud 80
moensii, Lethrinus 84
Monotaxis 91
Monotaxis affinis 24
Monotaxis grandoculis 91
Monotaxix indica 91
Mosambiekse keiser 60
mossambica, Wattsia 93
mossambicus, Gnathodentex 93
Mozambique emperor 60
Mozambique large-eye bream 93
Mu 92
Mulla 76,80
Muneaka-kuchibi 90

N

Naked-headed sea bream 30
nebulosus, Lethrinus 75
nematacanthus, Lethrinus 61
Ninuki 90
Nise-hana-fuefuki 52
Njana 78
Nokogiridai 18
Nor'-west snapper 76
nuageux, Lethrinus 76
nubilis, Lethrinus 67
Nyamvi 72
Nyanvi 80
Nyavi 72,80

O

obsoletus, Lethrinus 77
obsoleta, Sciaena 77
ocumaculatus, Gnathodentex 17
Odeo uturoa 80
Oeo tiamu 90
Oeo utupoto 90
olivaceus, Lethrinus 78
Ome-meichidai 31
Onaga meichidai 24
Oo-fuefuki 72
opercularis, Lethrinus 67
Orange-spotted emperor 57,58
Orange stripe emperor 78
Orange-striped emperor 77,78
Oranjekol-keiser 58
Oranjestreep keiser 78
orbis, Gymnocranius 28
Ornate emperor 80
ornatus, Lethrinus 80

P

Pacific yellowtail emperor 48
Pagrus heterodon 91
Pallan 92
Palu hakka 80
Palutput 62
papuensis, Lethrinus 64
Paradentex 18
Paradentex marshalli 27
Pentapus curtus 27
Pentapus dux 27
Perche à lignes d'or 18
perselectus, Lethrinus 75
Phelele 76
Pig-face bream 69
Piggy 67
Pink ear emperor 67
Pink-eared emperor 69
Portrait 65
Pulli vella meen 76
Purple-eared emperor 69

R

ramak, Sciaena 77
Red-ears 84
Red-finned emperor 67
Red-gilled emperor 84
Redsnout emperor 81
Red-throat 67
Red-throated emperor 74
Redaxil emperor 53
Redaxil emperor 54
Redspot emperor 69
Reticulated emperor 49
reticulatus, Lethrinus 81
rhodopterus, Lethrinus 64
richardsoni, Lethrinus 63
Rippled barenose of Gerimpelde kaalneus 28
nvulatus, Dentex 27
Roba 72,80
Robinson's sea bream 28
robinsoni, Dentex 27
Rooikol-keiser 69
Rooiskof-keiser 54
rostratus, Lethrinus 78
rostratus specificus, Lethrinus 78
rubrioperculatus, Lethrinus 83
rüppellii, Gymnocranius 27
Rythung-filolu 90

S

Sand snapper 76
sanguineus, Lethrinus 69
Sapingan 49,80
Sazanamidai 28
Sciaena grandoculis 91
Sciaena obsoletus 77
Sciaena ramak 77
scoparius, Lethrinus 75
semicinctus, Lethrinus 84
Shaoor 65,69,71,90
Shaoor mehseny 76
Sheiry 52,65,69,71, 72,76,90
Shimofuri-fuefuki 69
Shirodai 25
Shoor 72
Sinagub 65
Sky emperor 69,71
Slender emperor 88
Smalltooth emperor 71
Snapper bream 67
Snubnose emperor 51,52
sordidus, Lethrinus 84
Sororo 89
Soudanné 89
Spangled emperor 75,76
Sparus aureo-lineatus 17
Sphaerodon 91
Spotcheek emperor 83,84
Spotted sea bream 32
Starry pigface bream 76
Stompneus keiser 52
striatus, Lethrinus 59
Striped large-eye bream 17
Swallowtail sea bream 24
Swarkol-keiser 65
Sweetlip 74
Sweetlip emperor 74

T

Tabutu 65
Tailgi 92
Taiseiyo-fuefuki 51
Tama-meichi 32
Tamure 49
Tateshima-fuefuki 78
Thangu-chaa 28
Thinan 80
Thumbprint emperor 64,65
Tipuake 80
Tricky snapper 49,74
Trumpet emperor 73
Trumpeter 74
Tsangou 69
Tseen tsuy la 64
Tseen tsuy tso 64
Tsivaravaramena 28
Tsongue 76
Tuamotu emperor 49
Tukwana 76

U

Ura hota 80

V

Vanaka 80
variegatus, Lethrinus 88
Vella meen 76,78
Vipuake 90
virescens, Lethrinus 67

W

waigiensis, Lethrinus 78
Wattsia 92
Wattsia mossambica 93

X

xanthochilus, Lethrinus 89
xanthopterus, Lethrinus 78
xanthotaenia, Lethrinus 80

Y

Yaeyama-fuefuki 82
Yellow morwong 49
Yellow-spotted emperor 58
Yellow-striped emperor 81
Yellow sweetlip 76
Yellow-tailed emperor 49
Yellowlip emperor 89,90
Yellowsnout large-eye bream 26
Yellowtail emperor 54
Yokoshima fuefuki 48
Yokoshima-kurodai 92

Copyrighted material

7. COLOUR PLATES

PLATE I

1. *Gnathodentex aurolineatus*
2. *Gymnocranius audleyi*
3. *Gymnocranius elongatus*
4. *Gymnocranius euanus*
5. *Gymnocranius frenatus*

PLATE II

6. *Gymnocranius grandoculis*
7. *Gymnocranius griseus* (adult)
8. *Gymnocranius griseus* (juvenile)
9. *Gymnocranius microdon*
10. *Gymnocranius* sp.
11. *Lethrinus amboinensis*

PLATE III

12. *Lethrinus atkinsoni*
13. *Lethrinus atlanticus*
14. *Lethrinus borbonicus*
15. *Lethrinus conchyliatus*
16. *Lethrinus crocineus*
17. *Lethrinus enigmaticus*

PLATE IV

18. *Lethrinus erythracanthus* (adult)
19. *Lethrinus erythracanthus* (juvenile)
20. *Lethrinus erythracanthus*
21. *Lethrinus erythropterus*
22. *Lethrinus genivittatus*
23. *Lethrinus haematopterus*
24. *Lethrinus harak*

PLATE V

25. *Lethrinus laticaudis*
26. *Lethrinus lentjan* (adult), silvery pattern
27. *Lethrinus lentjan* (adult), barred pattern
28. *Lethrinus mahsena* (adult), form *mahsena*
29. *Lethrinus mahsena* (adult), form *sanguineus*
30. *Lethrinus microdon* (adult), silvery pattern

PLATE VI

31. *Lethrinus microdon* (adult), mottled pattern
32. *Lethrinus miniatus* (adult), silvery pattern
33. *Lethrinus miniatus* (adult), barred pattern
34. *Lethrinus miniatus* (adult), redtail pattern
35. *Lethrinus nebulosus* (adult)
36. *Lethrinus nebulosus* (juvenile)
37. *Lethrinus obsoletus*

PLATE VII

38. *Lethrinus olivaceus*
39. *Lethrinus ornatus*
40. *Lethrinus reticulatus*
41. *Lethrinus rubrioperculatus*
42. *Lethrinus semicinctus*
43. *Lethrinus* sp. 1

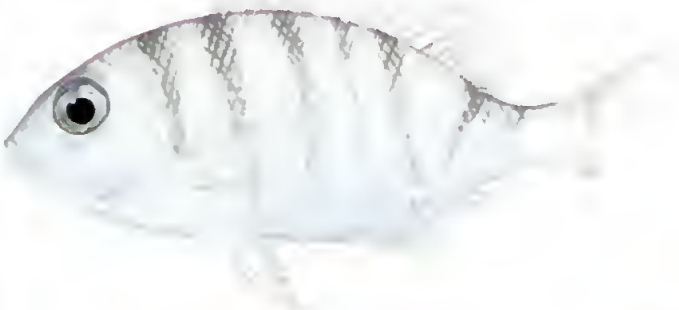
PLATE VIII

44. *Lethrinus* sp. 2
45. *Lethrinus variegatus*
46. *Lethrinus xanthochilus*
47. *Monotaxis grandoculis* (adult)
48. *Monotaxis grandoculis* (subadult)
49. *Monotaxis grandoculis* (juveniles)
50. *Wattsia mossambica*

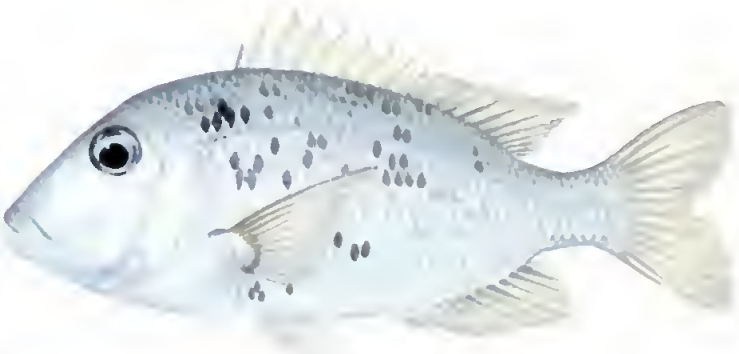
PLATE I

1. *Gnathodentex aurolineatus*
(ill. Swainston)

2. *Gymnocranius audleyi*
(ill. Swainston)



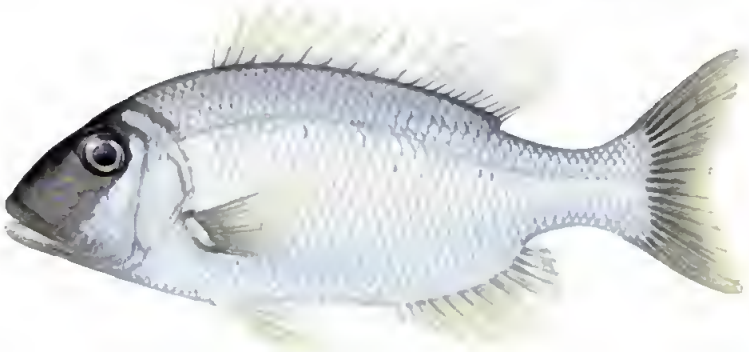
3. *Gymnocranius elongatus*
(ill. Swainston)



4. *Gymnocranius euanus*
(ill. Swainston)

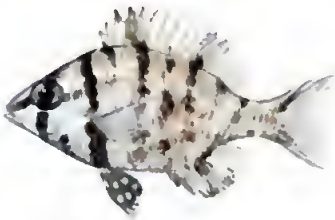
5. *Gymnocranius frenatus*
(ill. Swainston)

Copyright material



6. *Gymnocranius grandoculis*
(ill. Swainston)

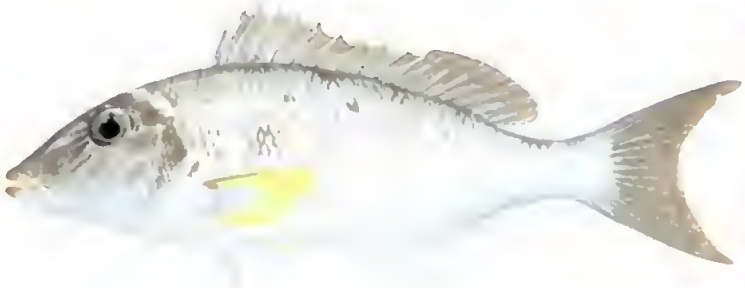
7. *Gymnocranius griseus* (adult)
(ill. Swainston)



8. *Gymnocranius griseus* (juvenile)
(ill. Swainston)

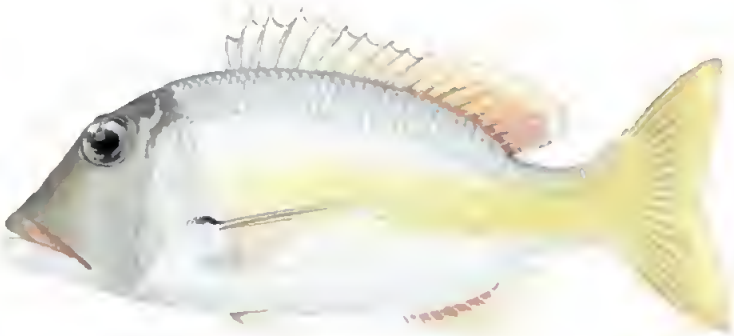
9. *Gymnocranius microdon*
(ill. Swainston)

10. *Gymnocranius* sp.
(ill. Swainston)

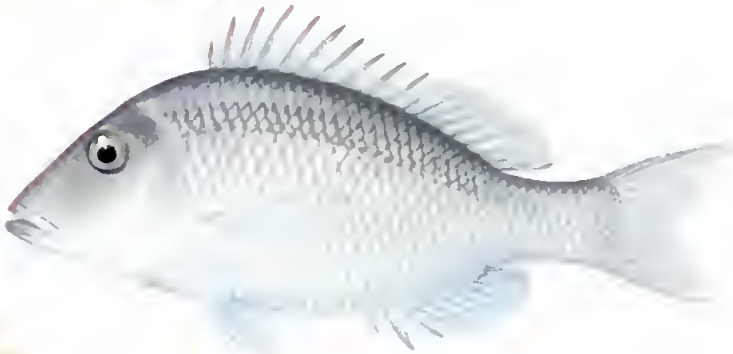


11. *Lethrinus amboinensis*
(ill. Swainston)

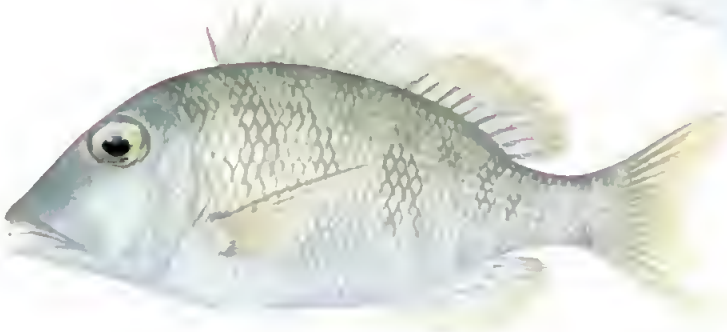
Copyright Control



12. *Lethrinus atkinsoni*
(ill. Swainston)



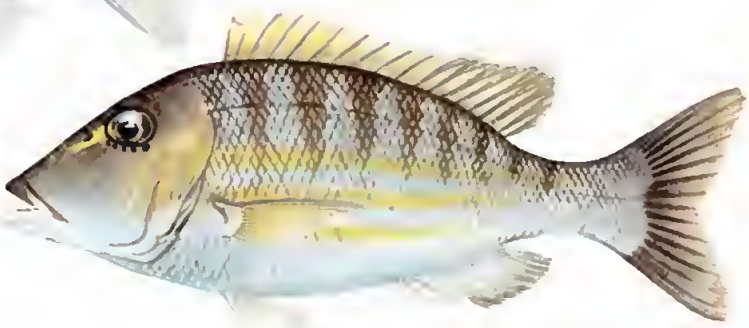
13. *Lethrinus atlanticus*
(ill. Swainston)



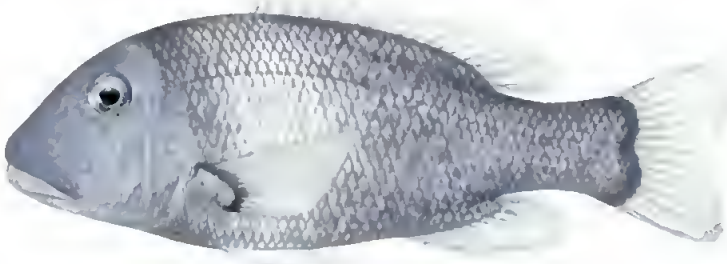
14. *Lethrinus borbonicus*
(ill. Swainston)

15. *Lethrinus conchyliatus*
(ill. Swainston)

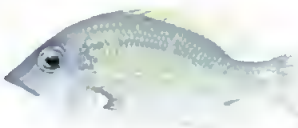
16. *Lethrinus crocineus*
(ill. Swainston)



17. *Lethrinus enigmaticus*
(ill. Lastrico)

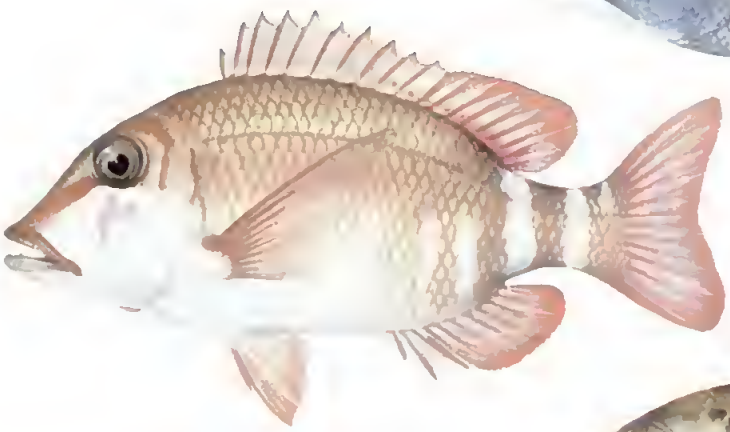


18. *Lethrinus erythracanthus* (adult) (ill. Swainston)



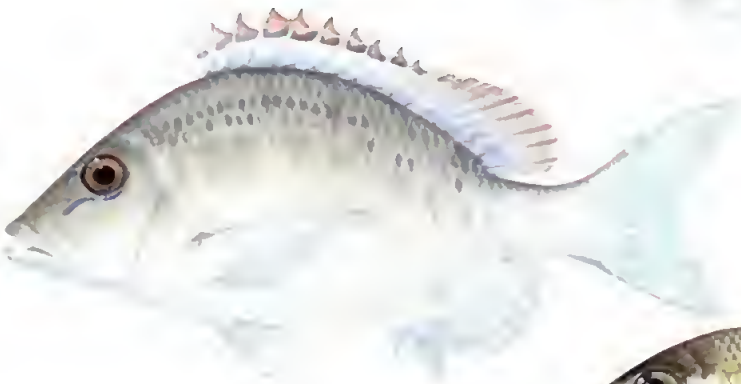
19. *Lethrinus erythracanthus* (juvenile) (ill. Swainston)

20. *Lethrinus erythracanthus* (ill. Swainston)



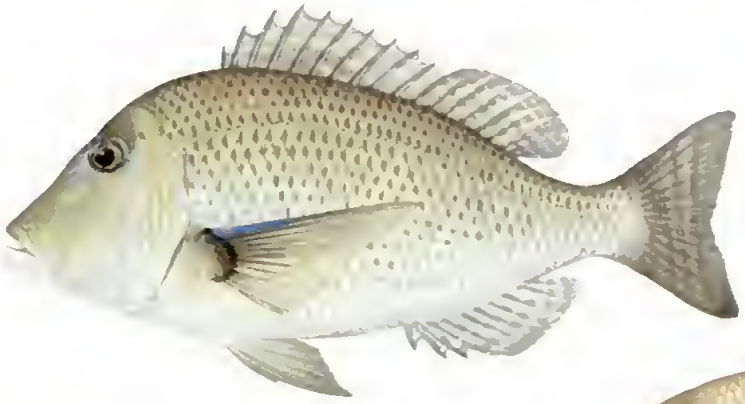
21. *Lethrinus erythropterus* (ill. Swainston)

22. *Lethrinus genivittatus* (ill. Swainston)



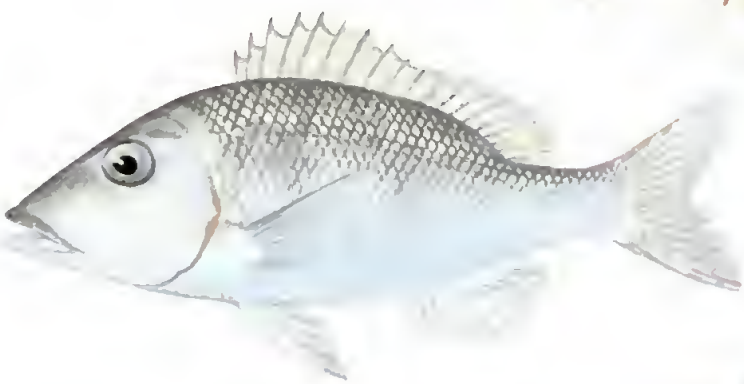
23. *Lethrinus haematopterus* (ill. Swainston)

24. *Lethrinus harak* (ill. Swainston)



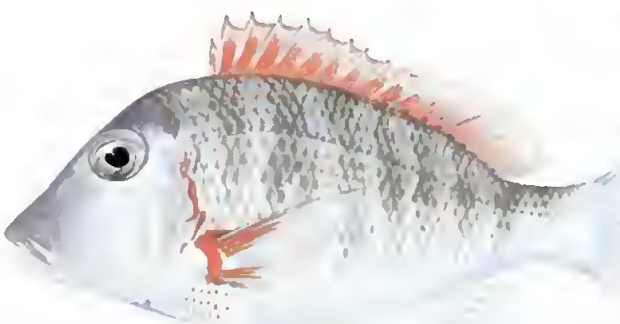
25. *Lethrinus laticaudis* (ill. Swainston)

26. *Lethrinus lentjan* (adult), silvery pattern (ill. Swainston)



27. *Lethrinus lentjan* (adult), barred pattern (ill. Swainston)

28. *Lethrinus mahsena* (adult), form *mahsena* (ill. Swainston)



29. *Lethrinus mahsena* (adult), form *sanguineus* (ill. Swainston)

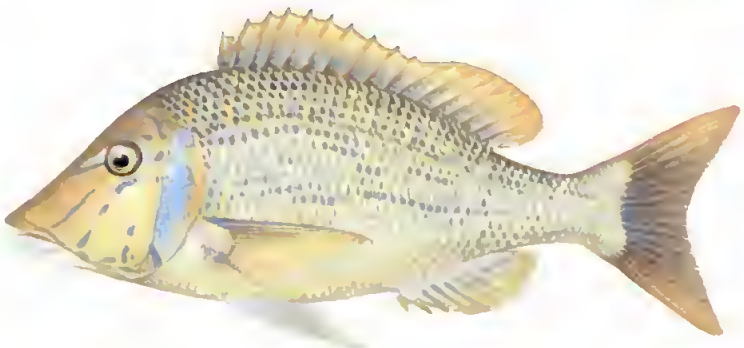
30. *Lethrinus microdon* (adult), silvery pattern (ill. Swainston)

31. *Lethrinus microdon* (adult), mottled pattern (ill. Swainston)

32. *Lethrinus miniatus* (adult), silvery pattern (ill. Swainston)

33. *Lethrinus miniatus* (adult), barred pattern (ill. Swainston)

34. *Lethrinus miniatus* (adult), redtail pattern (ill. Swainston)



35. *Lethrinus nebulosus* (adult) (ill. Swainston)

36. *Lethrinus nebulosus* (juvenile) (ill. Swainston)

37. *Lethrinus obsoletus* (ill. Swainston)

Copyright material

38. *Lethrinus olivaceus*
(ill. Swainston)

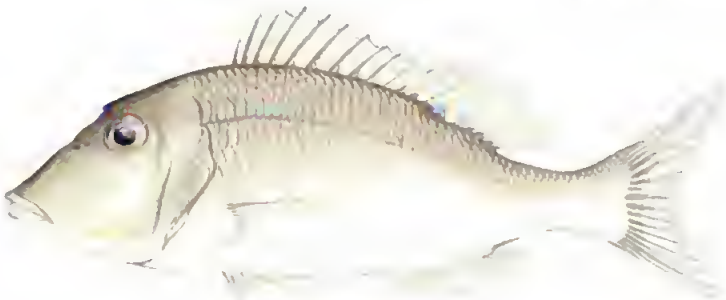
39. *Lethrinus ornatus*
(ill. Swainston)

40. *Lethrinus reticulatus*
(ill. Swainston)

41. *Lethrinus rubrioperculatus*
(ill. Swainston)

42. *Lethrinus semicinctus*
(ill. Swainston)

43. *Lethrinus* sp. 1
(ill. Lastrico)

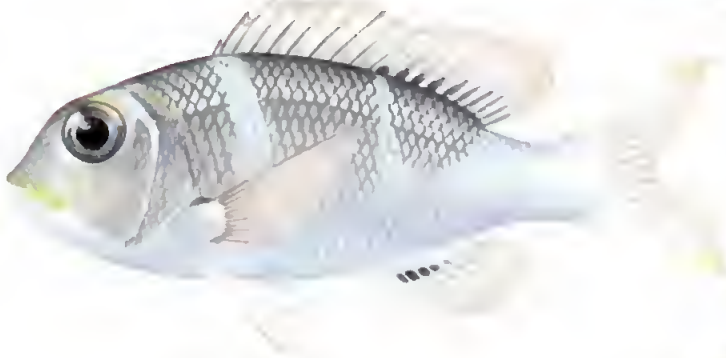


44. *Lethrinus* sp. 2
(ill. Lastrico)

45. *Lethrinus variegatus*
(ill. Swainston)

46. *Lethrinus xanthochilus*
(ill. Swainston)

47. *Monotaxis grandoculis*
(adult) (ill. Swainston)



48. *Monotaxis grandoculis* (subadult)
(ill. Swainston)

49. *Monotaxis grandoculis* (juvenile)
(ill. Swainston)

50. *Wattsia mossambica*
(ill. Swainston)

M-40/T0242E/1/1.90/2500
ISBN 92-5-102889-3